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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, AUGUST 22, 1929 Number 8

A Professional Contribution

CERTAIN of the most troublesome problems encountered by the engineer as a professional man are courageously attacked in the report of a special committee to the American Society of Civil Engineers. It centers about the subject of charging for professional services, but goes much beyond this, inasmuch as it also deals with bidding, competitions and other sorely disputed matters. When the report reaches the members of the society, a week or two hence, it should engage intensive study. Incisive discussion will follow, it may be hoped, in order that the many phases of the group of problems at issue shall be scrutinized in the light of manifold experience and by the test of varied conditions of application. After reading an advance copy we feel fully warranted in characterizing the report as courageous, broad and judicious; but it nevertheless offers opportunity for critical weighing of many of its pronouncements. Through active co-operation of the practicing engineers of the country a foundation may be laid for any revision necessary to make the report express truly and fairly the essentials of engineering business procedure for most useful service to the community. Such difficult questions as bidding and competition—the discussion of which is clear and helpful but probably does not go to the root of the matter—or engineering service by teachers and public officials, or guarantee of cost, or engineering by contractors, give large scope for thorough canvassing of all aspects of practice. But the many contributions of basic value made by the report (to cite a single example, its treatment of the structural engineering situation) give full assurance of its lasting value when finally approved and adopted by the society. Its study will make the engineer a wiser business man and the profession a sounder group.

Ownership in the Heavens

OUR contemporary *Aviation* advances the interesting thesis that property rights in the space above ground may in future be limited, and probably should be limited. In view of the fact that all of the civil engineer's work is closely connected with property rights, not only on the surface but above and below the surface as well, the matter is worth thinking about. The case around which *Aviation's* comments revolve is that of a golf club near New York, alongside whose grounds a flying field has been established. Planes leaving and approaching this field often fly low over the links, endangering the security or the peace of mind of the golfers, wherefore the club authorities have proposed to build a row of towers along the dividing line, to form an effective fence. It is not hard to see how the air enthusiast would compare such a structure with the familiar "spite fence" and overlook its legitimate function as a protection; he is likely to hold that its erection violates the equities of the case. Hence the suggestion that either now or in future certain limits to a property owner's air rights will be recognized. The conception of such a limit, however, appears to imply that the construction of any high edifice might become subject to the approval of flying interests, at least to the extent that a clear showing of necessity would be required before it could be undertaken. A factory building, a chimney or a transmission line, for example, would be placed under more or less serious limitations. In the present state of human needs it is difficult to see how such a condition could be made tolerable. But the mere fact that it could be seriously proposed forecasts the coming of a clash of interests which the civil engineer needs to keep in view.

Mexican Highway Progress

TWO highway undertakings of quite different character but of common interest to the people of the western United States are described in this issue. One calls for the opening of through road service to Alaska and the frigid North and the other for highway connection with the tropics of Mexico. It will be surprising to most engineers to learn that only 750 miles remain to complete highway connection with Alaska. This is less than the mileage of surfaced road built yearly by many states. Interest in the Mexican roadwork arises from the fact that the southern republic's highway development program now seems set on a solid basis. With its new powers the national highway commission is developing an organization of its own country's engineers and is collecting its energies in a more purposeful manner than was evidenced in the exploitation period that followed inauguration of the work. There is now a clear plan and purpose in Mexico's national roadwork, and construction is going ahead intelligently and conservatively under the direction of its own officials and engineers. With the improved national finances there should come even greater possibilities of new mileages of improved roads. Perhaps the most significant promise of this future acceleration of highway construction lies in the activity being shown by the Mexican states in inaugurating road improvement supplementing and co-ordinating with the national highway program.

A World Movement

ALMOST daily much newspaper space and type-matter is given over to remarks on the world's advance toward a state of enduring peace, but little is said of the world's progress in roadbuilding. Yet it is possible that the latter may prove more real and lasting than the former. China perhaps excepted, more roads and better roads are a controlling motive of development in virtually every country of the globe, and in each case this motive springs from the recognition that physical isolation with its resultant intellectual and business isolation is no longer tolerable in these days when motor vehicle and modern road can overcome it. That the Mexican

roadwork is the beginning of a new era in the republic is hardly open to question; that a through road to Alaska will change the growth of that remote region profoundly is equally beyond doubt. So Cuba's great highway is sure to leave its impress on development. And in every country, roadbuilding followed by increased mobility and closer contact of region with region brings about decades of advance within a few years. These are conditions which lend special fascination to current reports of new road enterprise in various corners of the earth. Moreover, they give good reason for anticipating that, just as many far-distant countries are now learning from American road experience, we shall in time have occasion to profit by what they have developed.

Alteration Hazards Again

REPEATED instances in the past have shown the serious hazards that may arise in alteration work, a matter to which we had occasion to refer only a few months ago. Yet the Los Angeles near-accident described this week is valuable not only as a fresh reminder of its importance but also as a demonstration of the trouble that may result from carelessly cutting through a vital part of a reinforced-concrete structure. Something remotely similar, on a small scale, happened not long ago on a piece of building construction where the footing of a wall was reinforced to act as a continuous distributing girder; the builder cut this girder through in order to make a cellar doorway, and in due course a group of bad settlement cracks became visible in the wall, radiating from the doorway. These cases from practice give point to the doctrine that structural members in concrete construction need careful guarding, both while the work is going on and subsequently during the life of the structure. That there are similar possibilities in steel-frame construction was emphasized some years back when a high building in Philadelphia was being altered by putting new and larger store windows in the first story; the alteration contractor found some large knee brackets in his way and cut them out with the burning torch, regardless of the fact that they formed a vital part of the windbracing of the building. When this was noticed, quite by chance, hurried steps were taken to put in new windbraces as a substitute for the burned-out brackets. It is customary to look on alterations lightly, especially as the work usually involves only moderate cost and therefore seems to be nothing that requires calling in a structural engineer. Yet there are many ready ways in which the security of the structure may be impaired even by apparently trivial alterations. The case reported this week shows particularly well how the failure to obtain competent counsel in carrying on alterations may lead to heavy expense in repair or rehabilitation.

Progress in Car-Ferry Railway Links

THE municipal car ferry constructed by Milwaukee as part of its improved harbor works points to the growing importance of a navigation service not commonly recognized by the shipper. Each year the demand of traffic for expedition between the East and the Northwest and between Canada and the United States emphasizes more the barrier which the chain of the Great Lakes offers to direct rail routing. So far the pressure has necessitated overcoming the barrier only in case of Lake Michigan. Here there are nine across-lake ferries operated by five railways among fourteen ports. These not only shorten the travel routes to Wisconsin, Minnesota and the farther Northwest but they eliminate the delay of passing through the congested Chicago gateway.

As transportation plant installations the Lake Michigan car ferries deserve high rank among engineering works. Maintenance of winter and summer service on schedule demands vessels that will weather severe storm and ice conditions. The modern car transport is therefore an inclosed-deck, twin-screw, high-powered steamer quite different from the open-deck-barge car ferries at New York, Detroit and other cities on rivers. There are indeed few examples of more perfect naval engineering than some of the recent ice-breaking car-ferry boats operating across Lake Michigan. In the terminal engineering, however, there is remarkable simplicity; car transfer between shore and boat demands no more complex structure than a hinged bridge or apron with a gallows-frame counterweighted hoist.

But while the problem of transfer structure is simple, there is a major problem in harbor entrance and shelter and in shore yard facilities for quick clearance and interchange of cars. Until the new municipal terminal at Milwaukee, the interchange yard track system has been the engineering and financial task of the railways, and like any other private structure of the owning railway it has been held by the owner for disposition of service as he willed. The municipal ferry introduces the new feature of general transportation accommodation, and its success will be observed with attention. In harbor entrance and shelter work it is important to note that the government engineers also have in recent years given large consideration in their harbor work to serving car-ferry transportation.

With the increasing importance of cross-lake transfer lines as links in long-distance rail routes, both the port and the terminal problems indicated become matters for consideration by Great Lakes cities. Their municipal development contains distinct possibilities in building up community business. The availability of a municipal union terminal conceivably offers inducement for establishing car-ferry connections by many rail lines that now are not warranted in making the investment required for individual transfer terminals. It is possible, then, that in the Milwaukee municipal terminal there is inaugurated a far-reaching future possibility in lake and rail transportation development.

Sidewalk Congestion

WHILE traffic experts and city planners devise crosstown boulevards, one-way streets and other means to keep wheeled traffic moving with a minimum of interference, pedestrian traffic on the sidewalks seems to be left with little or no protection from encroachment of various kinds which seriously impede movement. Few items in the operation of cities do as much to clog and choke the community organism as does sidewalk blocking. Its effect in busy districts is the same as that of equivalent roadway encroachment, for the street extends from house to house and the moving crowds will take their due proportion of its width.

A survey of San Francisco conditions reveals obstructions of many different kinds, the existence of none of which is warranted on busy thoroughfares. Every city shows the same condition, though the nature of the obstructions may differ. Entrances and stands, display and even storage of goods are common forms of obstruction; plainly, these things belong within the house line and not in the street. In some city districts it is common practice

to use the sidewalk as a loading platform, to block it by a truck or to use it as a builder's working space—a direct appropriation of property belonging to all the people for the benefit of one. In a multitude of ways the city's pedestrian traffic is crowded, inconvenienced and slowed up. Yet with all the development of vehicular transportation, the man on foot remains the basic and most vital unit of urban transit.

Poles carrying wires were long ago removed from busy sidewalks. It is time that fire hydrants were also taken out of the street area. Sidewalk elevator covers left open all day to ventilate basements, advertising signs, flower stands and the like can be dealt with more promptly if the authorities will but act to carry out their clear duty.

Politics has been a prime supporter of this particular evil; it is one of the easiest forms of political favor to authorize a sidewalk encroachment or to wink at commercial use of a public way. But responsible and intelligent persons often contribute their share without illegitimate purpose, as when subway entrances are built on the sidewalk area even in regions of densest crowding. The basic trouble is the tradition that the sidewalk is an appurtenance of the adjoining property. But the pressure of city traffic makes the sidewalk problem one of the most urgent in municipal improvement. It invites closest study in every community where traffic difficulties have made themselves felt.

To Guide Bridge Welding

UNUSUAL promise for bridge welding attaches to the publication in this issue of a specification for arc-welded connections in bridges. It is a timely and much needed document, and will be questioned only by those few who still look upon a specification somewhat as a last will and testament, or something to be written only after a wealth of experience and data has been collected over a long period of years. That we do not subscribe to this conception of a specification has been stated in these columns before. A specification for any art or process is a safety measure and an efficiency guide to be drawn up at the earliest possible moment. It is not a final document, but, like a balance sheet, it sets forth the condition of the art as of a certain date and implies the necessity of change as soon as conditions or developments warrant. So the bridge-welding specification now offered purports to do no more than to represent experience to date with arc-welded bridges.

Any doubt that a specification is timely at present will be readily dispelled by considering some of the numerous welded bridge projects that have been completed. To mention only a few: An upper deck has been added to a highway bridge over the Susquehanna River at Havre de Grace, Md.; extensive repairs have been made to a combination highway and traction bridge at Bound Brook, N. J.; a railway bridge over the Missouri River at Leavenworth, Kan., has been strengthened and repaired; a plate-girder railway span at Pittsburgh and a through-truss railway bridge at Chicopee Falls, Mass., have been built; and finally, several railroads, among them the Chicago & North Western, the New York, New Haven & Hartford and the New York Central, have repaired some of their important structures by welding. Thus the two prime requisites for a specification are present in the field of welded bridges—first, a growth in the use of the process requiring guidance and safeguards, and second, a sufficient amount of successful pioneer work to provide data for standards of practice.

The present specification is not the last word. Its author admits as much, styling it a tentative specification. Nevertheless it is the first comprehensive specification to be drafted, and since it is based on methods which have proved themselves in practice its provisions should not be violated except by those who are certain of their ground. With this specification as a beginning and with constant and continuing efforts to check its provisions or to disprove them with better data, welding on bridges and other structures subjected to dynamic stresses can go forward more safely, economically and rapidly.

Human Adjustment

WHEN a young engineer receives his degree and enters professional life, two courses are open to him: He can draw into his shell, subordinating his identity, and face the probability of always having his nose to the grindstone in a struggle for existence; or he can enter into the spirit of the organization with which he is connected and become an active, co-operative part of that organization. In the vast majority of cases, perhaps in every case without exception, the latter is vital if he is to make his life truly useful.

The one-man effort of a generation or two ago has gone into the limbo of discarded things and in its place there is co-ordination and co-operation of the whole body of officials and employees that constitute the organization. Those at present in high positions did not get there by holding themselves aloof and taking the attitude that any ideas they might advance would have no effect on policies. Policies are now determined after many plans have been discussed by many men, and new ideas are welcomed from whatever source they come.

Some take the attitude that if good ideas are suggested by them and are adopted someone else will get the credit and reap the benefit. These men are harboring a delusion. Likewise the day is past, if it ever existed, when a reputation for wisdom can be obtained by taciturnity. The engineer, young or old, is falling far short of his full opportunity to influence and lead if he does not throw himself wholeheartedly into the teamwork of his organization and realize the great possibilities of accomplishment through well-geared co-operation.

So much for the selfish side of the question. There is another side—the opportunity to advance engineering achievement in general by hearty co-ordination with others. It is well to recall that each individual element has an influence on the general result in proportion to his sympathetic understanding of the major problems at issue and his fellowship with his coworkers. In short, his engineering influence is dependent on the human quality which he applies to his share in the joint enterprise.

Neither engineering training nor professional practice gives definite impetus to the development of this co-operative spirit. It is the engineer's own responsibility to develop this part of his equipment, and to begin on the work as early as possible, in order to take advantage of the flexibility of his younger years. The single elements of the human mechanism can succeed in contributing their influence only by integrating themselves with the entire co-operative organization and by making its ends their own. The engineer who succeeds in this endeavor will find his knowledge and influence effective in determining the productiveness of the organization. He who does not is quite likely to remain a pawn to be moved about at the will of others.

Developing a Nation-Wide Road System

Modern Methods Followed in Planning and Building Highway Links Throughout Mexico—National Commission Handles Location, Construction and Maintenance—Difficult Topography Encountered

By Vicente Saucedo
Civil Engineer, Mexico City, Mexico

IN FOUR CENTURIES which have elapsed since draft animals and wheeled vehicles were introduced into Mexico, a network of 66,000 miles of highways has gradually spread over the country, but as the result of pioneer necessity rather than of engineering design. Scarcely one-third of this mileage will carry modern traffic, and perhaps not more than 30,000 miles give service of some sort throughout the year. The advent of railroads during the latter third of the nineteenth century and their subsequent expansion into the 15,000-mile system of today afford only partial relief toward economic transportation. Aside from the fact that railroads have not yet penetrated into several important regions, many productive zones actually crossed by them cannot be properly developed owing to the lack of highways for supplementary communication.

For more than a generation back, and even more perceptibly since the introduction of automobiles, there has been a latent desire all over the country for better roads. This spirit has been manifested in the initiative taken by local authorities and private organizations in building and improving isolated stretches. These scattered efforts, however, have been at a disadvantage on account of the limitation of resources and scope. A more fruitful move was made by the federal government when it organized, in March, 1925, the National Highway Commission, with the twofold purpose of building roads and co-ordinating the activities of the local authorities and private organizations.

Program of Development—To this end a definite outline was conceived from the outset for the construction of a nation-wide system of primary thoroughfares, to be used as the framework for the subsidiary or secondary roads to be carried out under the state governments. Examples of the new main roads are shown in Figs. 1 and 2. The network shown on the general map, Fig. 3, was projected after a careful reconnoissance of the ground, in conjunction with population and economic surveys. In the accompanying table is given the classification of the routes, with the length completed and the work now planned. The program for 1929 includes not only the 310 miles of new roads listed in the table but also the finishing of some portions already opened, as well as some relocations. By the end of 1934 there will probably be completed an additional 2,000 miles, with an approximate expenditure of $66,000,000 (Mexican currency).

Every state is crossed by at least one thoroughfare, and all the state capitals are conveniently connected to the system. Parallelism with the existing railroads has

FIG. 1—DEVELOPMENT AT PETAQUILLAS ON THE MERIDIAN HIGHWAY FROM MEXICO CITY TO ACAPULCO

FIG. 2—PAN-AMERICAN HIGHWAY, MEXICO CITY TO PUEBLA SECTION
Looking toward the valley of Mexico City. Elevation, 8,550 ft.; grade, 6.2 per cent.

been avoided as much as consistent with fundamental considerations of economy or convenience, and several cross-connections have been provided in the more populated zones. The extent of the subsidiary net of local roads has not been determined or even yet completely planned, but it is surmised that it will eventually exceed 50,000 miles if some portions of the existing old roads are adapted for motor traffic.

Gasoline Tax and Funds—A tax on first-hand gasoline sales amounting to 3c. per liter, Mexican currency, or 5½c. per gallon, U. S. currency, was established by law for roadbuilding and for the operation of the commission. Although this revenue has more than doubled in three years, the federal government has furnished additional funds from general resources in order to advance the work. The increase in revenue is an index of the intensification of traffic and shows in a practical way that the tax has been looked upon with favor. Taking advantage of the public attitude, an increase was made on Jan. 1, 1929, to 4c. per liter (7½c. per gallon).

Construction Standards—With a definite program on hand and with assured resources, the commission, in order to cover as much ground as possible, advisedly adopted the policy of developing an extensive mileage of roads adequate for light and medium traffic, rather than undertaking costly surfaced construction of a shorter length. Standards adopted provide for initial roadway widths from 16 to 18 ft., to be increased as traffic may demand. Where traffic is expected to be light in the next few years and where difficult topography would cause high costs, sharper curves and steeper grades are allowed

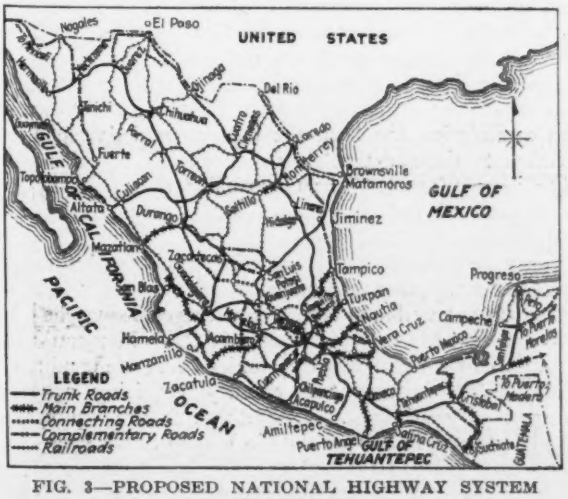


FIG. 3—PROPOSED NATIONAL HIGHWAY SYSTEM OF MEXICO

than in those sections subjected to heavier traffic. On the Acapulco road, for instance, there are a few curves with radii of 48 and 55 ft., and stretches with grades of 8 and 9.5 per cent, but these extremes will be reduced when the traffic demands it. In general, the curves seldom have radii of less than 100 ft. and the grades seldom exceed 6 per cent. Typical sections are shown in Fig. 4. The surfacing naturally bears a relation to the duty imposed on the road. For light traffic an 8-in. gravel course, properly shaped and consolidated with a clay binder, has been used. In the more populated districts a water-bound macadam has been employed, further protected in some cases by one or more applications of oil incorporated by the penetration process.

The Pan-American and Meridian Highways—In order of importance, not only for Mexico but for the continent at large, the Pan-American and the Meridian highways stand out in first place. It is natural therefore, that

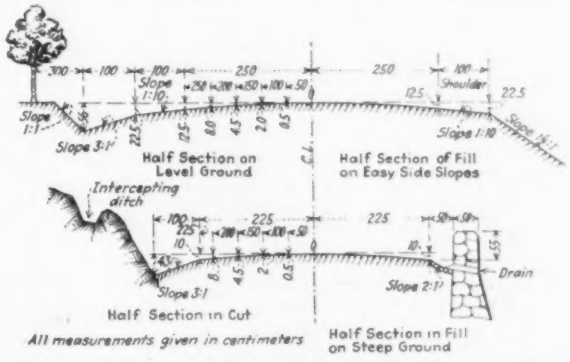

Half Section on Level Ground
Half Section of Fill on Easy Side Slopes
Intercepting ditch
Drain
Half Section in Cut
Half Section in Fill on Steep Ground
All measurements given in centimeters

FIG. 4—TYPICAL SECTIONS FOR MEXICAN NATIONAL ROADS

these should have received preference. They have a common trunk from Laredo, at the border line with the United States, to Mexico City, where they branch into two distinct roads. The Pan-American branch enters Guatemala at Suchiate, while the Meridian highway extends southerly to Acapulco, on the Pacific coast.

Between Laredo and Mexico City, 763 miles, the work hs progressed 240 miles from the border to a point south of Linares, Nuevo Leon, and 140 miles from Mexico City north to a point beyond Taxquillo, Hidalgo, a total of 380 miles in actual service. It is expected that the intervening gap of 383 miles, practically half of the entire distance, will be closed by the end of 1930, as it presents fewer difficulties than the portions already open. On the Pan-American branch between Mexico City and the Guatemalan frontier, 620 miles, the portion between Mexico City and Puebla, 83 miles of oil-treated road, was finished last year (see Fig. 2), while the state governments of Chiapas and Oaxaca have built 155 miles in their respective localities farther south, making a total of 238 miles on this branch and leaving 382 miles scheduled for completion within the next five years. Summarizing these figures, it will be seen that of the 1,383 miles corresponding to the Mexican section of the Pan-American highway 618 miles are in service and that the completion of the remaining 765 miles is scheduled for 1934.

Mexico City to Acapulco—The southern section of the Meridian highway, between Mexico City and Acapulco, was opened last year. This achievement is most significant, because this road not only gives ready access from central Mexico to a much desired outlet on the south coast of the Pacific but at the same time

unlocks a heretofore inaccessible region abounding in forest and mineral resources and very promising in agricultural possibilities. The length of this road is 284 miles, or about 100 miles longer than the straight line distance between the terminals. The mountainous configuration of the country made the location unusually difficult, requiring much skill and judgment in development so as to attain economy in construction and convenience in operation.

As the valley of Mexico is bordered by some of the loftiest mountains on the continent, separating it from the coasts, it is unavoidable to climb first to some favorable pass from which to start the descent. In this case, besides the upper ranges there are two lower chains, rising more than 2,500 ft. above their respective valleys, that had to be crossed on the way to the coast, as shown in the profile, Fig. 5. A segregation of the plus and minus grades into two groups gives the equivalent profile indicated by the dotted line, showing at a glance that in order to gain the upper valley a virtual ascent of 19,143 ft. has to be made, even if 11,794 ft. are spent later in the subsequent descent. It is obvious that by following the river courses this disadvantage might have been largely eliminated, but this expedient would have increased the length of the road considerably. [This profile may be compared with the profiles of a railway location survey between Mexico and Acapulco, given in *Engineering News-Record* of April 26, 1928, p. 661. —EDITOR.]

For motor traffic and short freight hauls, economy of construction and distance saved may counterbalance the disadvantage of steep grades and sharp curves. In the present case it is proposed to reduce the steeper grades and to modify the curves as soon as the volume of traffic justifies the change. The character of the country and an interesting development of a 12-mile stretch are shown in Figs. 1 and 6. The bridge across the Papagayo River (Fig. 7) is the most important structure so far on this road, though the Mexcala bridge will surpass it. Some typical views of mountain location on the Mexico City-Puebla road, which is a portion of the Pan-American highway, are shown in Figs. 2 and 8.

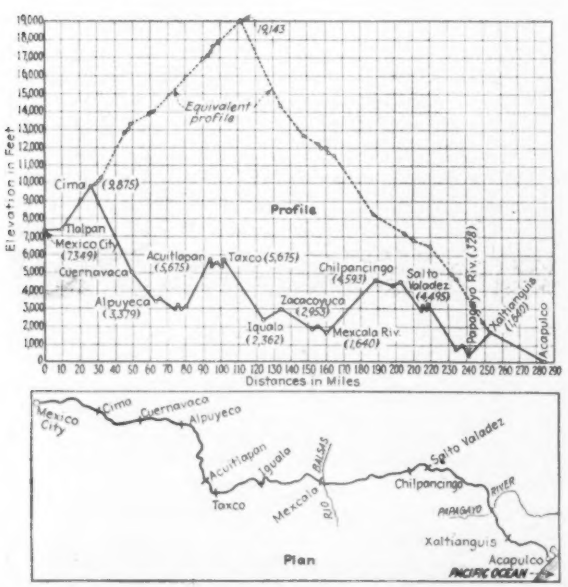


FIG. 5—NATIONAL ROAD FROM MEXICO CITY TO ACAPULCO

FIG. 6—ACAHUIZOLA CANYON ON THE MERIDIAN HIGHWAY

Construction Methods—Road work is being done in accordance with specifications prepared by the commission, and standard methods have been adopted, except for slight modification to suit special conditions. A great variety of local materials has been submitted to laboratory and practical tests, and those found satisfactory are being used to economic advantage. Low labor wages and the difficulty of transporting machinery into some regions made the employment of hand labor not only advisable but unavoidable at first, but this has been largely displaced by mechanical equipment, in which the commission has invested upward of $5,000,000 (Mexican currency). Medium-sized power shovels are used in deep earth cuts, and scrapers in the lighter portions, while compressed-air drills and explosives are extensively employed in rock work. The preparation, conformation and surfacing of the roadbed and road proper are done with crawler tractors, graders and surfacing machines of medium-heavy type, along standard lines and methods. Lighter equipment of similar nature is used for maintenance. This equipment is complemented with a line of portable crushers, mixers, tanks, rollers, trucks and motor cars.

The greater bulk of the work is being awarded by contract on the unit-price basis; the cost-plus system adopted at the beginning has been discontinued. So far there are few contractors in Mexico with sufficient means and experience to undertake road work on a moderately large scale, and the present practice is to let out to a single organization stretches not exceeding 20 or 30 miles at a time, while the incidental structures are given out separately to smaller outfits. One of the tasks of the commission has been the training and development of men to the end that they may qualify for this purpose in the future. The commission also furnishes at least part of the equipment that is required by the contractors.

Very economical results are being obtained through systematic organization, and although no comprehensive statement is possible in regard to averages, it may be said that the cost has ranged between $6,000 (Mexican) per kilometer in the level territory under favorable conditions and $60,000 in mountain country requiring a large amount of earthwork. These figures are equivalent to $4,830 and $48,300 per mile in United States currency. Altogether $25,000,000 (Mexican) has been spent in building about 930 miles of roads and in making investi-

gations, explorations and surveys. The total is approximately grouped into 170 miles of oil-treated roads, 300 miles of water-bound macadam and gravel roads and 480 miles of earth roads.

In addition to the work carried on under the commission, the state governments not only have some important projects under earnest consideration but have about 300 miles under construction. More than half of this length has been completed, and it is expected that in a few years their operations will surpass in volume those of the federal government. This general interest was revealed at the road congress which met in Mexico City early in October, 1928, attended by delegates from all over the country, as well as by delegates from other nations. Many interesting projects were presented for discussion at this congress and it is confidently expected that most of these projects will materialize in the course of a few years.

Highway Traffic Conditions—At the end of 1925 there were in Mexico 53,500 motor vehicles of all kinds. According to preliminary figures furnished by the Department of National Statistics, based on imports and

FIG. 7—REINFORCED-CONCRETE BRIDGE OVER THE PAPAGAYO RIVER
Meridian highway, Mexico City to Acapulco section.

allowance for discards, the number at the end of 1928 was 75,600, showing an increase of 22,100 vehicles, or 41.2 per cent of the original number. The imports for 1928 alone amounted to 15,350 cars, buses and trucks, having a factory invoice value of $21,600,000 (Mexican currency) and amounting to more than 20 per cent of the total number of vehicles. When freight, duty and dealers' profits are added to the original amount, it totals nearly three times the expenditure in roadbuilding during the year. As the imports for the previous years had not reached 5,000 vehicles, it is evident that the increase must be ascribed in large part to the effect of the new roads.

Counts of traffic made at different times over the principal roads give the following averages: Mexico-Puebla road, 350 vehicles per day; Mexico-Pachuca, 250; Mexico-Cuernavaca, 150; Laredo-Linares, 100; and Cuernavaca-Acapulco, 50. The traffic near the larger cities is much larger, exceeding 3,000 vehicles per day in the case of Mexico City and its vicinity. The preceding figures prove the sound judgment of the commission in adopting the policy of extensive mileage suited for light traffic and of waiting until the traffic becomes heavier before building more costly roads.

Maintenance System—The maintenance and repair of these roads fall under the jurisdiction of the National Highway Commission, and for this purpose it organized at its inception a special department. This work is divided into two classes: (1) maintenance and repairs proper, and (2) improvements. At first the patrol

STATUS OF NATIONAL ROAD WORK IN MEXICO, 1929

Classification	Program (Miles)	Completed (Miles)	Under Construction (Miles)
Main thoroughfares crossing the country	8,000	747	260
Main branches tapping important zones or providing desirable outlets	1,900	26	
Connecting roads	1,200	177	50
Complementary roads	4,500		
Totals	15,600	950	310

The Oaxaca-Chiapas section, built by state governments, is not included in this tabulation.

method for maintenance and repair was employed, but this system has been abandoned, as it involved dead expense in some portions, scattered responsibility and required exacting inspection. At present the roads are divided into sections of variable length, and each section is covered by one or more gangs of laborers, under a foreman. These gangs take care of the repairs with hand tools and light equipment. The annual upkeep cost of oil-treated roads has averaged $1,250 (Mexican currency) per kilometer ($1,000 U. S. currency per mile), while the gravel and earth roads average $650 per kilometer ($523 U. S. currency per mile). Altogether, somewhat more than $800,000 (Mexican) was spent on this item last year.

When the traffic increases to such a point that the expense of upkeep exceeds a reasonable limit, the original inexpensive surfacing is replaced by one of higher grade and with better wearing qualities. This work is undertaken by the section in charge of improvements, which also has under its care the changes in alignment and grades when the original conditions become inconvenient for traffic and when the increase in traffic justifies the change.

Personnel—Present members of the National Highway Commission are Octavio Dubois, Antonio Madrazo and

FIG. 8—CAT ROCK (PENA DEL GATO), PAN-AMERICAN HIGHWAY
Near the summit of the section between Mexico City and Puebla.

Francisco Diaz Leal. Charles M. Upham has been consulting engineer from the inception of the work, and Julio Garofa is in charge of special investigations. S. G. Quevedo has succeeded F. J. Sanchez as chief engineer, and L. Farias is assistant chief engineer; S. Toscano, V. Q. Gama, J. L. Gonzalez and C. Franco have charge of the exploration and location work in different parts of the country.

Donnelly Dome, on the Richardson Trail, Alaska

International Highway Planned to Alaska

Already More Than Half the Roadway Distance Has Been Spanned and There Remain Only 750 Miles to Be Completed

By Kendall K. Hoyt
Of the Washington Staff, Engineering News-Record

Ernest Walker Sawyer, executive assistant to the Secretary of the Interior, has just returned from a two months' trip in which he traveled 4,000 miles by air, rail, boat and auto through the principal settled regions of Alaska. He was sent by the Interior Department to study Alaskan conditions and reports an increasing field of engineering activities, especially in road construction as described by this article. Mr. Hoyt's interview of Mr. Sawyer is the background of the following article. —Editor.

FRONTIERS develop most rapidly with through highway connections. This philosophy, well known to ancient Rome, is just beginning to be applied to Alaska as plans for an auto road from Seattle to Fairbanks are being actively considered. This is no vision. Already more than half the roadway distance has been spanned. One can drive in reasonable comfort to a point near the Pacific seaboard farther north than the end of the Alaskan panhandle. Closing the gap by an inland route to Fairbanks will take time, but presents no unsurmountable difficulties.

After the steady and stable growth of Alaskan industries in recent years, an international highway is the next logical step toward making the northern territory accessible to trade and travel. Alaska is ready for it. Its metal mining is on a large-scale, low-grade-ore basis and does not depend on a few rich deposits as in the gold-rush days. Vast forests await pulpwood development. The $50,000,000 salmon industry is yielding $3,000,000 to the territory and the reindeer industry gives promise of equaling it within a few short years. Wheat, barley, oats, peas, beets, lettuce, celery and all manner of field and garden crops are being grown in the open and under glass on a scale which already satisfies a large part of the Alaskan demand. Foxes, mink and beaver are being raised extensively for the fur trade. These activities indicate that the proposed highway is not a mere jump into the wilderness.

Route and Construction Distances—Of the 2,000 miles of road necessary to connect Fairbanks with Seattle, in round numbers, 1,250 miles already are completed. The Alaskan mileages are: constructed, 100 miles; to construct, 200 miles. The new work required in Canada is 550 miles plus the raising of 150 miles of wagonroad to automobile standards. Little of the road will be at more than 3,000 ft. elevation.

Starting at Fairbanks, the proposed route follows the existing highway 100 miles to McCarty, with a 200-mile extension along the Tanana River to the Yukon border. Thence it spans 150 miles to Kluane Lake, connecting with a completed 100-mile stretch into Whitehorse and pushing on 50 miles to the British Columbia line, where a road runs 25 miles into Atlin. The gaps through the Yukon will be a heavy expense to such a sparsely settled territory, but will open country of high scenic value.

British Columbia, however, would carry most of the burden, since the long break from Atlin to the road above Hazelton is 350 miles, or nearly half the uncompleted distance. From Hazelton a highway goes through to Seattle. British Columbia is spending large sums on highways, and Governor Bruce is reported to have said that $1,000,000 per year would be warranted for the international project.

Feeder Connections—At the Alaskan end of the proposed highway a network of feeder lines is fast developing. The existing roads from Fairbanks to Circle, one of the northernmost settlements, to Valdez on the southern coast, and to Chitana on the Copper River Railroad

already throw open a large area to auto travel. Connections to Anchorage and to Dawson are foreseen in the not distant future. It is expected that about $1,000,000 per year is going into Alaskan highways, all of which eventually will connect as feeders.

Other feeders undoubtedly will go down the Taku River to Juneau and down the Stikine River to Wrangell. These roads involve heavier construction work than is encountered inland, because of the intervening coast range, which is high and rocky. However, this section is heavily mineralized and such feeders should result in developing large mines comparable with the Juneau mine, which now handles 12,000 tons of gold ore per day.

The existing railroads from Fairbanks to Seward, Whitehorse to Skagway, Cordova to Kennicott, and Hazelton to Rupert of course will be important parts of the system, as will be the steamboat service on the long Yukon and Tanana rivers. A traveler could come in by the international highway and return with his car by steamship from Seward, or he could drive to Circle and take a six weeks' boat trip down the Yukon.

Travelers' Facilities—The attraction of recreational travel into Alaska will be one of the main functions of the international highway, not only because of the direct income from tourists but on the safe assumption that casual visitors will become settlers or investors. Although Alaskan travel possibilities have been little advertised, traffic during summer months often has been all that could be accommodated. Increased hotel space is being provided and roads are being extended to the main scenic features, especially in the McKinley National Park.

Seasonal Aspects—Of course the highway would be open only about six months of the year due to snow conditions, but some American roads operate under similar disadvantage. In much of the country through which the Alaskan route will travel, the subsoil is frozen throughout the year, although the surface thaws and vegetation springs up during the summer months. Roads usually become passable by June at the latest.

In highway construction the surface growths are removed and a little preliminary grading is done, after which the roadway is left to thaw. With the protective covering removed, the ground thaws to bedrock or at least for a considerable distance downward. The next year it is possible to complete the regular road grading. Sand and gravel deposits suitable for surfacing material are to be found all along the route within short hauling distances.

ALONG THE HIGHWAY IN JUNE
This gives an idea of the snow conditions existing when the roads are first being opened.

Government Construction Activities—Highway work in Alaska is under the Corps of Engineers, Major Malcolm Elliott being president of the Alaskan Road Commission, in charge of construction. Since 1913 a comprehensive program has been under way, including auto roads, wagon roads, pack trails and dog sled trails. Hard surfacing is not yet economically feasible. Good gravel roads of the type used through many Western states are being laid for auto traffic. The principal projects are the Richardson highway, from Fairbanks to Valdez, and the Steese highway, from Fairbanks to Circle. The average cost of high-class gravel roads in Alaska is about $10,000 per mile. Estimates for the proposed international highway run about $15,000 per mile. Maintenance costs have not been found excessive.

Specifications for the Richardson highway call for a width of 32 ft. in flat country, a maximum grade of 8 per cent and maximum curvature of 100-ft. radius. Culverts are of corrugated iron pipe. A light timber suspension type has been adopted for most bridges in which natural round wood rather than sawed lumber is used in many instances. Shelter cabins are built as a regular part of the highway program.

Highway Economics—Some authorities state that the Alaskan highways now in use have paid for themselves already. An annual saving of $2,000,000 in transportation costs has been effected, it is stated, not to mention the increased production which has been encouraged through cheaper transport. In extreme cases, under the conditions which formerly prevailed, haulage charges ran as high as $50 per ton-mile. Transport was then limited to the open watercourses in summer and their frozen beds in winter. Wagons could go up some gravelly streambeds. Travel overland was possible in the summer by pack horse or on foot with swift streams and

PROPOSED INTERNATIONAL HIGHWAY
From a base map compiled by the U. S. Geological Survey.

A TYPICAL ROADHOUSE IN THE REGION

quicksand hazards for the traveller to contend with. The present system of roads and trails are in use except for about three weeks in the spring and fall, when the change in seasons halts traffic. Aside from trucks and wagons, tractors are sometimes used to good effect, especially over sledge trails which are impassable to other vehicles. Winter transport is mainly by dog sled on the highways, frozen streams, or on the special trails. Airplanes also operate on runners over the snow.

Airways Development—Tying into the highway at many points is the existing airways system. Alaska already has 71 landing fields, and more are in progress. Air taxis run from the principal towns to all inhabited parts of the territory, thus forming an important link at all times of year. The plane is being used in exploration as well as transport in the present naval air-mapping expedition, which is photographing large areas in co-operation with the U. S. Geological Survey.

Captain Hoyt's recent flight demonstrates the further possibility not only that Alaska can readily be reached by air but that the northern territory will serve as a base for later commercial lines to Asia. It is pointed out that a great circle from New York to Tokyo passes a little north of Fairbanks, from which fact may be appreciated Alaska's strategic position in such a system—which may come into being sooner than most expect. Next year the "Graf Zeppelin" is to undertake Arctic exploration with Fairbanks as a base, which work incidentally will throw further light on the air transport problems that exist in the far north.

Railroad May Pay—That the Alaskan Railroad has been operating at a loss should not be taken as a shadow over the economic feasibility of the highway project. While the railroad has been going behind about $1,000,000 per year, the annual deficit is decreasing and new developments, reindeer in particular, promise to put the line on a paying basis.

Reindeer first were imported into Alaska to relieve the native half of Alaska's 60,000 population. Having fulfilled this purpose, changing the Eskimos from a fishing to a pastoral people and furnishing sustenance where life otherwise could not be supported, the flocks have increased to nearly 1,000,000 head. It is estimated that a steady export volume of 300,000 carcasses per year could be maintained to the American market, where a demand is being built up. Although non-competitive in volume and use, reindeer meat now sells in New York for about the price of beef.

Aside from mining advances, the reindeer is the best thing that has happened to Alaska since the gold rush. Present plans contemplate driving the animals overland from the western coastal regions to the rich Tanana Valley, where they will be fattened on Alaskan grain and shipped out by rail to the seaport at Seward. This will furnish a heavy freight business and will help balance the preponderance of inward shipments on the railway.

An incident on Mr. Sawyer's trip illustrates the limited knowledge of Alaskan resources, not only those destined for remote use but those which could be utilized on a paying basis today. While flying over an area west of Mount McKinley, Mr. Sawyer's pilot was forced off course because of fog. The party passed over a territory which, due to its swampy surroundings, had been believed worthless. Mr. Sawyer thought the area looked like reindeer country and flew low to investigate. Later verification of this discovery reveals 4,000,000 acres of the best grazing land of Alaska, which will form an important path for driving the deer overland and concentrating them for quick delivery to the railroad.

Drawbacks Are Overbalanced—There is, quite literally, a darker side of the Alaskan picture in the long winter nights and in the summer fog, rain and mosquitoes and other disadvantages which will make parts of the territory submarginal land for some time to come. These things must not be overlooked by those who tend to lay out the prospectus in too glowing terms. On the other hand, these obvious obstacles are a proof that such industry as has been able to survive and grow has done so for sound economic reasons. While nothing is foreseen at the present time to justify any sudden boom in Alaska, most authorities who are in touch with recent developments are not inclined to be pessimistic over the prospects for steady progress. As a material aid to this advancement, the proposed highway program not only will be an investment in possible futures but will form a part of an economic structure which already has proved itself.

Checking Phenol Pollution in Lake Michigan

PREVENTING coke-oven plants on the Calumet River, Chicago, from causing pollution of Lake Michigan by their phenol wastes was a step effected in November, 1928, toward checking general pollution of the lake by sewage and industrial wastes. Three large byproduct coke-oven plants are involved. At that of the Youngtown Sheet & Tube Company, such wastes will be pumped to a city sewer leading to the Calumet sewage-works, the phenol load being too small to interfere with the biological functions in the Imhoff tanks. At the plants of the Wisconsin Steel Company and the By-Products Coke Corporation, the ammonia wastes will continue to be discharged into the river as long as it has its normal flow from the lake to the Chicago drainage canal. Whenever heavy rainfalls or other conditions cause danger of reversal of flow, so that the wastes might be carried to the lake, the companies will be notified and will then store either the weak ammonia liquor or the wastes from the stills until normal conditions of river flow are restored. Each company will provide storage capacity sufficient for five days' production of wastes. As to the water in the drainage canal, it is considered certain that there will be no trouble or nuisance due to the phenol wastes. The health department of the Sanitary District of Chicago, which effected these arrangements in co-operation with the three companies, will take samples of river water daily, or oftener when necessary, to determine the amount of phenol pollution.

Steel Bar Joist Construction in a Garage and a Hotel

Absence of Formwork, Co-ordinated Work of Various Trades and Construction Speed Are Features

THE USE of steel bar joists in the floors is a notable feature of two structures recently erected—a ten-story apartment hotel in Cleveland and a three-story ramp garage in Asheville, N. C. No formwork was required for the floors in either structure, the slab being poured directly on rib floor lath placed on the bar joists. Steel work, floor lath, electrical conduits, floor slabs, piping, etc., were all installed very rapidly and without interference one with the other. Numerous other details of the structures are worthy of note.

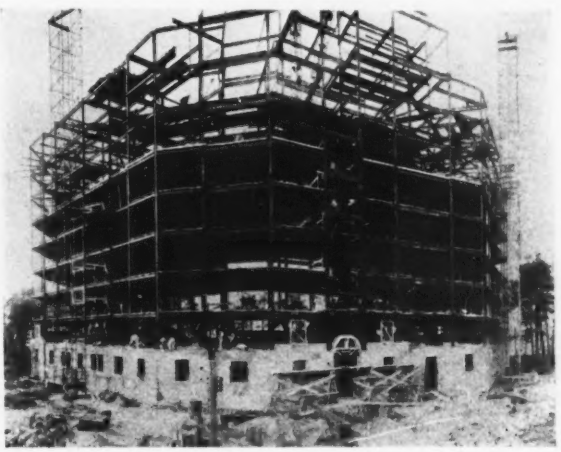


FIG. 1—FRAMEWORK OF LAKE SHORE APARTMENT, CLEVELAND
Building is in the shape of a U, open on the far side and facing Lake Erie. Note absence of formwork.

Lake Shore Hotel—The Lake Shore Hotel, at Lakewood, Ohio, a suburb of Cleveland, is a ten-story structure on the shore of Lake Erie, costing approximately $2,780,000. The building is in the form of a U, opening toward the lake, with the corner angles splayed at 45 deg. A noteworthy part of the project is a basement garage which extends under the entire court area.

The plans called for a structural steel frame and bar joist floors with a 3-in. monolithic concrete slab poured on $\frac{3}{8}$-in. rib floor lath and reinforced with $\frac{3}{16}$-in. round temperature bars placed diagonally to the joists on 18-in. centers. The court area was also roofed over with bar joists and a concrete slab, on which was placed a 16-in. earthfill and landscaping. Original plans calling for a mushroom-type concrete column and slab roof were changed to steel column and bar joist construction, resulting in an estimated saving of $10,000. The building involved 1,500 tons of structural steel and 380 tons of joists.

Unusually rapid erection characterized the project. Structural steel was first delivered to the job on Aug. 10, and the frame, together with the floor lath, was completely erected by Oct. 20. Three guyed derricks were used for erection. Two principal construction elevators hoisted the bulk of other materials. The brick masons started after six floors of steel had been placed and averaged three floors per week in placing the face brick and back-up tile. The monolithic concrete slab was poured continuously in large squares and floated to a cement finish. A heavy bed of sawdust served as protection from operations above and to hold water while curing.

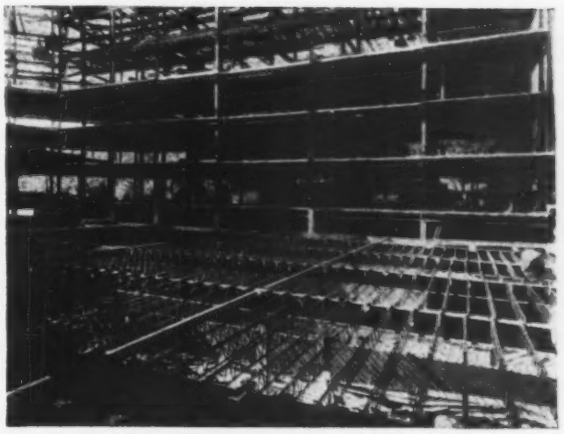


FIG. 2—BAR JOIST ROOF OVER COURT AREA
Basement below used as garage for tenants. Bar joists covered with concrete slab and 16-in. earthfill.

The general contract was executed by John Gill & Sons according to plans by and under the supervision of the Frank W. Bail Company, Cleveland. The subcontract for the structural steel, steel joists and floor lath was handled by the Forest City Structural Steel Company, Cleveland, Ohio.

Asheville Garage—The Conabeer Motor Sales Garage Building, of Asheville, N. C., is a three-story structure designed with interior steel frame and exterior bearing walls. It is trapezoidal in plan with 98-ft. frontage and 115-ft. depth. The typical floor panels, with spans ranging from 22 to 26 ft., were framed with 14-in. bar joists, while in the irregular-shaped panels 8- and 10-in. joists were used. The floors were designed for a live load of 150 lb. per square foot. The building was ready for occupancy within three months after steel erection started.

The floors consist of a 3-in. monolithic floor slab, poured on 4-lb. $\frac{3}{8}$-in. rib lath secured to the bar joists with wood lath wedges. Joist spacings were limited to 19 in. No tie beams were used, but according to the Macomber Steel Company, which furnished the joists,

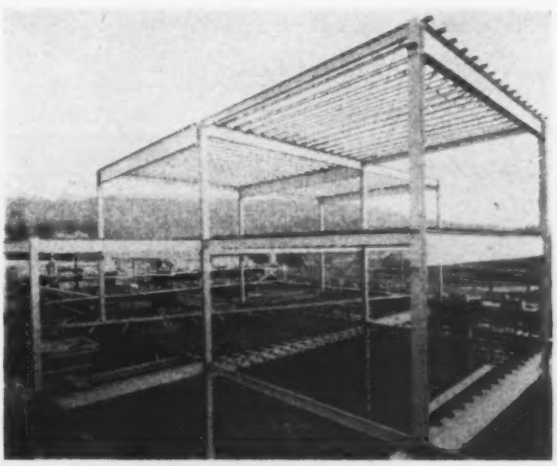


FIG. 3—FRAMEWORK OF ASHEVILLE GARAGE

FIG. 4—BAR JOIST FRAMING FOR GARAGE RAMP
Rib lath and temperature reinforcement in place.

the architects could have effected a slight saving by utilizing tie beams as joists; on the other hand, they eliminated the possibility of floor cracks over tie beams that might have occurred due to differences in deflection between the joists and the beams under full load.

The ramp is of particular interest. A tile wall on a steel girder forms the interior bearing for the joists for the initial rise of the ramp, while steel beams form the interior support for the remainder of the rise. The ramp flares at both the top and the bottom, requiring joist spans varying from 9½ ft. at the center to 12½ ft. at the ends. Standard 8-in. joists are used on the ramp, the same type of construction prevailing as was used in the floors. Steel spacing bars were clamped over the joist bearing plates to space the joists on the slope and to secure them to the beams.

During erection, the walls, structural steel and joists were carried up one floor at a time. According to the steel erector, all joists were placed and bridged at an average cost of 30c. each or approximately $4 per ton. The actual cost of the design as used figured 18½c. per cubic foot, including heating, plumbing and interior decoration of the salesrooms. The same company has now under construction a new eight-story office building utilizing steel frame bar joist construction.

Work Done by the French on the Panama Canal

An Appreciation of the Frenchmen Who Labored on the Canal Before the American Government Took the Work Over

By A. S. Zinn

Formerly Resident Engineer, Central Division, Panama Canal

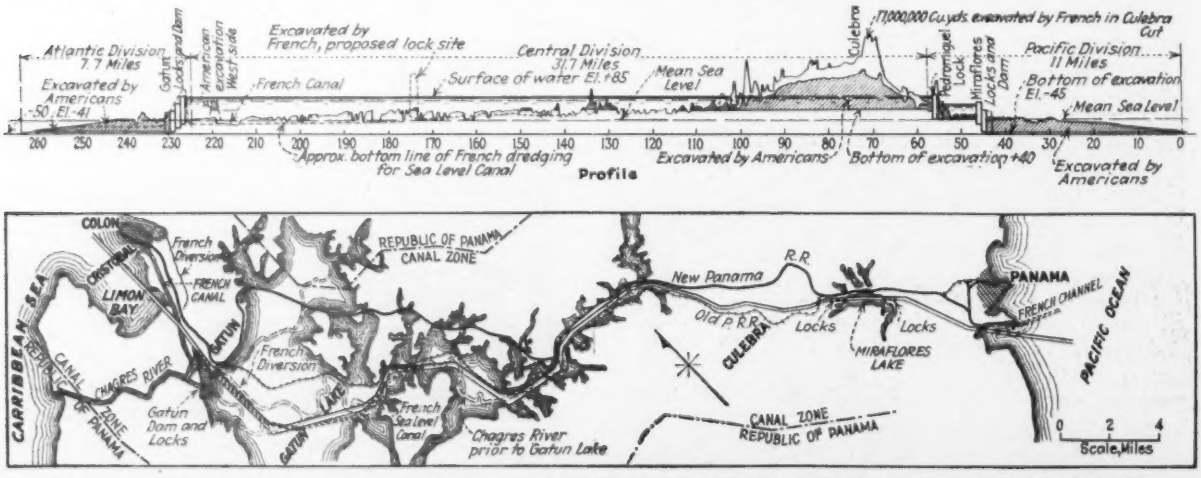
IT SEEMS to be the general impression that the French accomplished very little in the construction of the Panama Canal. This wrong impression is no doubt due to reading exaggerated newspaper reports and hearing public speakers who were not familiar with conditions and the work of the French on the canal. The accompanying map with profile shows the French location, with approximate lines of excavation, compared with the canal as built and now operated by the U. S. government.

It is the opinion of all Americans who spent years on the construction of the Panama Canal that the French did their work well and accomplished results which were little short of marvelous, when the conditions which surrounded them are taken into consideration. It is also their opinion that had similar conditions prevailed when the United States undertook the work, no better, if as good, results could have been secured.

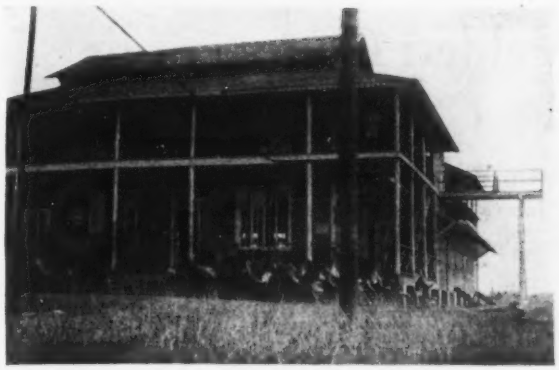
VALUE OF FRENCH PROPERTY AND WORK ACCOMPLISHED

Excavation	$25,389,240
Panama Railroad stock	9,644,320
Maps, drawings and records	2,000,000
Material and equipment	2,112,063
Buildings	2,054,203
Lands	1,000,000
Use of Pacific ship channel	500,000
Road—construction and clearing	100,000
Total	$42,799,826

The French were ignorant of the mosquito transmission of disease, for the discovery had not been made. They erected and equipped admirable hospitals at Ancon and Colon at a cost of $7,000,000 and office buildings and residences at a cost of more than $5,000,000, with paved roads to buildings. They also erected a splendid convalescent hospital (now Hotel Aspinwall) on Taboga Island, 10 miles in the Pacific Ocean from Panama. All of these hospital buildings were used by the Americans



PLAN AND PROFILE OF PANAMA CANAL SHOWING WORK DONE BY THE FRENCH AND BY THE AMERICANS



ENGINEERS' RESIDENCE AT EMPIRE
Built by the French and occupied by American engineers.

in addition to the ones they built, but since then all but the one on Taboga Island have been taken down.

The greater part of the French excavation was made by the old French company, 1881-88; during that time the number of deaths averaged about 2,000 men a year, which no doubt had a demoralizing effect on the employees. However, during that period they excavated about 68,000,000 cu.yd., and the new French company, working from 1894 up to time of American occupation May 4, 1904, excavated about 10,000,000 cu.yd., all in Culebra (now Gaillard) Cut, making a total of 78,000,000 cu.yd.

The total excavation by the French useful to the American lock canal was 28,000,000 cu.yd., of which about 70 per cent was rock. In 1911 a committee of six engineers, including the writer, who was resident engineer of the Central Division, was appointed by General Goethals to estimate the value of the French excavation and property to the American project. The total estimate was $42,799,826. It was my opinion that our estimate should have been close to $45,000,000.

FIRST BIG BLAST IN CULEBRA BY AMERICANS
Railroad track in the foreground was left by the French.

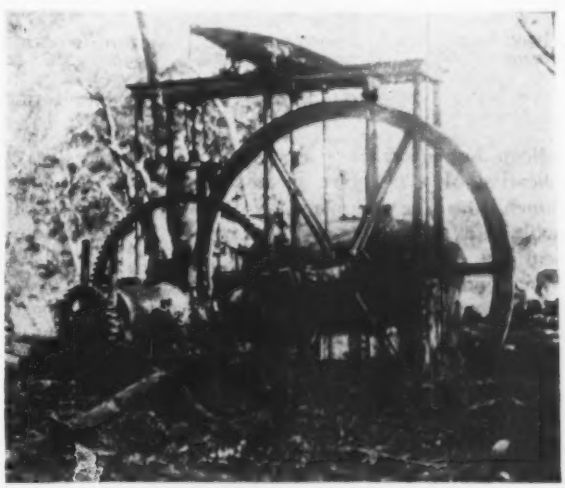
Without the pioneer work of the French, including valuable contour maps, the American engineers would no doubt have spent at least a year making surveys and plans to decide on the best practical location, to clear the jungles and start the work, even with much more modern equipment than was used by the French, and it would have required at least three years to excavate the 28,000,000 cu.yd. referred to above, as part of it was solid rock under water at the Pacific entrance. Therefore had it not been for the work accomplished by the French it would have required at least four more years for the Americans to complete the canal. So let us give full credit for the valuable work of the French on the Panama Canal.

Older Than the Iron Horse

Engine Built in 1818 Discovered Standing Among the Ruins of an Old Sugar Mill in Haiti

By G. A. Duncan, Jr.
Engineer in Chief, Republic of Haiti, Port au Prince

While on a trip on the southern coast of Haiti an interesting piece of machinery was brought to my attention. It was standing among the ruins of an



OLD SUGAR MILL ENGINE IN HAITI
This piece of machinery, built in 1818 and standing in the ruins of an abandoned mill, shows few signs of corrosion. This photograph was furnished by the Department of Public Works of Haiti, which is administered by officers of the Corps of Civil Engineers, U. S. Navy.

old sugar mill. The old engine bears this inscription embossed on its cylinder casing: "Joseph Lindsay & Company, Haigh Ironworks, Near Liverpool, 1818."

The engine is of one cylinder with a slide valve and a walking beam geared to a flywheel, which, in turn, is geared to the cane rollers. The cylinder is about 24 in. in diameter and has a stroke of about 4 ft. The most striking part is the boiler. It has no firepit or grate but there is a wall around it within which a fire was built. It is remarkable that the engine shows no sign of corrosion other than slight rusting.

This engine has historic value, as it was built about 30 years after James Watt improved the steam engine and is seven years younger than the first locomotive.

Specification for Arc-Welded Connections in Bridges

Based on Full Review of Test Data and Experience With Welded Bridges, a Tentative Specification Is Offered Covering Forms of Joint, Stresses, Methods, Workmanship and Inspection—Some Notes on Economy in Design

By Gilbert D. Fish

Consulting Structural Engineer,
Westinghouse Electric & Manufacturing Company,
New York City

SEVERAL arc-welded railway bridges have been constructed and numerous old highway and railway bridges have been reinforced by arc welding new steel to old. Economic advantages of the arc-welding process will doubtless cause rapid increase in its use for such purposes.

A specification to cover this practice, especially as to design of connections, is clearly needed. Limitation of numerical data on resistance of different types of arc-welded connections to repeated loading is temporarily a handicap, but information now at hand seems to justify publication of a tentative specification, which can later be amended. The following is offered in the belief that it will be a safe guide, even though a somewhat empirical one.

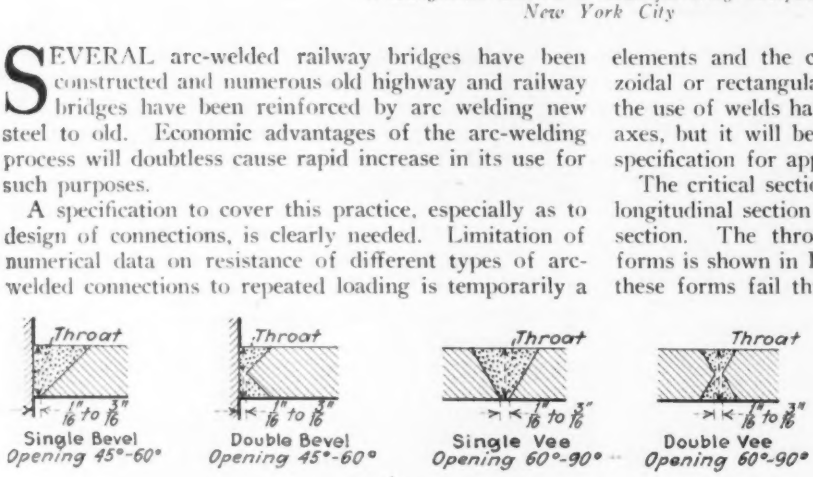


FIG. 1—FOUR TYPES OF BUTT WELDS

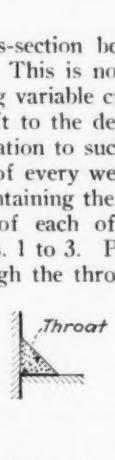


FIG. 2—FILLET WELD

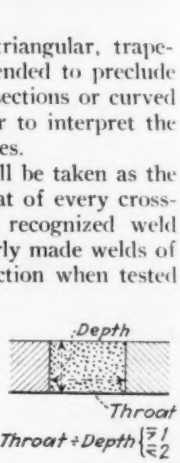


FIG. 3—SLOT WELD

Mainly on account of frequent application and removal of a large proportion of total load with attendant impact, bridges cannot properly be designed on the same basis of working stresses as buildings. This is especially true of short-span railway bridges. Fatigue resistance of the materials and their behavior under shock must be considered. In bridge-design practice it is usual to make allowances for impact and for reversal of stress as if they were additional loads, but to make no special allowance for mere repetition of stress.

The working stresses and rules for computing the applied stresses, as laid down in bridge specifications, furnish little guidance as to how working stresses should be determined from physical properties. It is necessary to refer to the general theory of strength properties of ductile materials, and to apply it to experimental data on certain strength properties of weld metal, in order to arrive at a rational basis of working stresses for welded connections subject to frequent stress variations.

Our practical concern is the behavior of welds and welded connections rather than with the properties of weld metal as a material; naturally the latter govern the former, but the relationships are not quite clear. Therefore we are obliged to consider particular forms of welds with which we have had experience and on which tests have been made.

For simplicity, welds will be considered prismatic in form, the length of weld being the length of the parallel elements and the cross-section being triangular, trapezoidal or rectangular. This is not intended to preclude the use of welds having variable cross-sections or curved axes, but it will be left to the designer to interpret the specification for application to such cases.

The critical section of every weld will be taken as the longitudinal section containing the throat of every cross-section. The throat of each of the recognized weld forms is shown in Figs. 1 to 3. Properly made welds of these forms fail through the throat section when tested to destruction. The critical area of a weld is therefore throat dimension multiplied by length.

The total stress transmitted by a weld may be expressed as a single centrally applied force plus a single moment (couple), either of which may be zero. As welds are poorly adapted to resisting moments about their longitudinal axes, they must always be arranged to avoid such moments. (Some bending moment of this kind inevitably occurs in fillet welds and slot welds transversely loaded, due to deflection of the stress in passing through the welds, but this is allowed for because it occurs in the test specimens on which our strength data are based.) Most welds occurring in practice are so symmetrically disposed in relation to the loading that each weld sustains only concentric loading, bending and torsional moments thus being avoided. In the exceptional case where bending or torsion occurs, its effect must be calculated and combined with the mean stress on the critical section: bending, acting about the transverse neutral axis of the critical section, induces tension or compression at each end of the weld, the intensity being equal to the moment divided by the section modulus of the critical section (throat $\times$ square of length $\div$ 6); torsion, occurring about the polar axis of the critical section, induces at each end a shearing stress approximately equal to the moment divided by the same section modulus above referred to. (This corresponds to the treatment of a line of rivets under the same condition.)

In all cases of longitudinal shear, and probably in transverse shear also, the stress is non-uniformly distributed over the critical section. It is sufficient for design purposes to deal with the mean shear due to any centrally applied load, because the effects of non-uni-

formity are covered by the tests on which our strength data are based. The following weld types are recognized:

1. Butt weld of trapezoidal cross-section conforming to any one of the forms in Fig. 1. The fused faces form the non-parallel opposite sides, the wide exposed face is flush with one of the faces of at least one of the connected members, and the entire weld is inclosed within the prism formed by extending the boundary planes of one of the connected members to intersection with the other member. The throat dimension is the distance between the bases of the trapezoid.

2. Fillet weld, having a cross-section in the form of an equilateral right triangle, of which the two legs lie in the fused faces. The weld is situated entirely outside the space inclosed by the boundary planes of the connected members extended to intersection. The throat dimension is the least altitude of the triangular section. (See Fig. 2.)

3. Slot weld, of rectangular cross-section connecting one face of one member with both sides of a slot in the other member. The throat dimension is the width of the slot and the depth of slot is required to be not greater than the throat and not less than half the throat. The weld exactly fills the slot. (See Fig. 3.) The slotted member must be designed so that its two flanks formed by the slot share the stress approximately equally.

The following cases of loading and combinations of the same (Fig. 4) are recognized: Case 1, butt weld in direct stress; case 2, butt weld in longitudinal shear; case 3, fillet weld in longitudinal shear; case 4, fillet weld in combined direct stress and transverse shear; case 5, slot weld in longitudinal shear; case 6, slot weld in transverse shear.

In addition to the above-listed elementary cases, bending or torsional stresses may be transmitted, provided they have no component about the longitudinal axis of the weld.

The combination of direct stress with transverse shear in case 4 involves complicated stress distribution which is not well understood. The strength properties of fillet welds loaded in this manner have been quite extensively tested, and it is fairly consistent with observed fact to treat the resultant stress as a shearing stress acting on the critical section.

Case 1 is to be designed for unit tension or compression. Cases 2 to 6 inclusive are to be designed for mean unit shear. For all six cases, unit stress is calculated by dividing the total stress by the critical area.

For a combination of cases 1 and 2, the resultant unit stress is oblique and is equal to the resultant total stress divided by the critical area. In the absence of experimental studies of this combination, the weld is designed for this oblique resultant stress as if it were normal tension or compression,* or for the mean unit longitudinal shear, whichever requires the larger sectional area.

For a combination of cases 3 and 4 or of cases 5 and 6, the resultant unit stress is an oblique shear (see previous discussion of conventional treatment of case 4), and the weld is designed for this mean unit shear.

For any combination of bending or twisting moment with any of the six cases or with a combination of two of those cases, allowance is to be made for the increase in critical stress caused by such moment.

Numerous tests have been made of ultimate resistance of butt welds in tension, and many of these tests have included measurements of yield point. Fillet welds of common size ($\frac{1}{4}$ to $\frac{1}{2}$ in.) have frequently been tested for ultimate resistance to transverse loading and for longitudinal loading, and some measurements of yield point have been included. The stresses in fillet welds transversely loaded are complicated and never have been satisfactorily analyzed, but their strength is as well known as that of butt welds. Tests of slot welds loaded longitudinally have shown a unit shearing stress on a throat section consistent with tests of fillet welds similarly loaded; it has not been usual to employ slot welds under transverse loading, and the writer is not aware that any destructive tests of their transverse strength have been made, but it cannot be far wrong to consider the shearing strength to be the same transversely as longitudinally. A considerable number of butt welds and a few fillet welds have been tested for endurance limit by the rotating-beam method, with the result that we have some experimental information as to the maximum intensity of direct stress which may be completely reversed an indefinite number of times without causing failure.

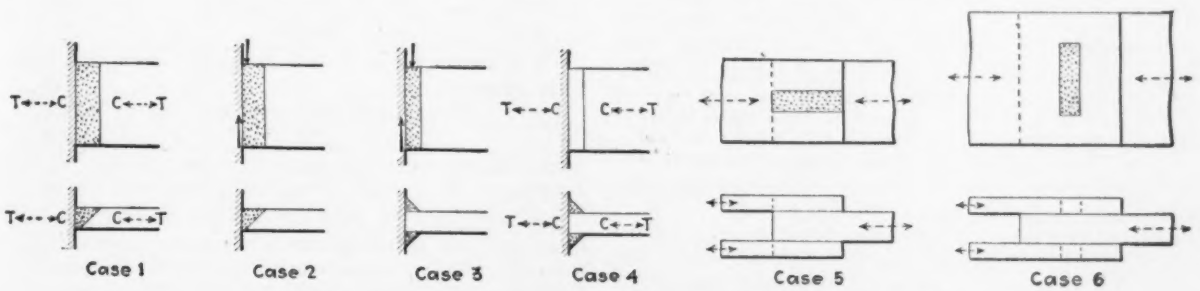


FIG. 4—LOADING COMBINATIONS ON BUTT, FILLET AND SLOT WELDS

The experimental data at hand are quite sufficient to establish the general fact that weld metal is in the class of ductile materials and that properly welded connections under stress behave in conformity with laws governing ductile materials, at least within the field thus far covered by tests. The writer proposes to assume the applicability of the current theory on the fatigue of ductile materials to all the cases covered by this discussion and to arrive at a numerical basis for design by taking conservative values for certain physical properties. Numerous qualitative tests of great severity have been made on the behavior of welds under shock, with results justifying confidence that if an impact factor is introduced the same as for the rolled steel members connected, and if unit

*This is not truly scientific but appears to be justifiable as an approximate treatment on the ground that it yields a compromise value between the normal component of stress acting on the critical plane and the major principal stress (the maximum direct stress on any plane).

stresses in the welded connections take due account of fatigue, then all vital points have been covered. Formal justification for these steps will not be attempted.

The treatment which follows is based on ideas brought out by the mechanics section of the Westinghouse Research Laboratory.

The general proposition is that a ductile material will withstand an indefinitely large number of variations of a given kind of stress between limits M and N, provided these limits conform to a certain condition which will be stated. Let M represent the numerical maximum and be considered positive; this makes M the algebraic as well as the numerical maximum. N is then the algebraic minimum, positive if the stress does not reverse and negative if it does. Stress range from 20,000 lb. per sq.in. tension to 4,000 lb. per sq.in. compression (or vice versa from 20,000 compression to 4,000 tension) would be represented by $M = +20{,}000$, $N = -4{,}000$. Shear limits of 12,000 and 4,000, both stresses acting in same direction, would be $M = +12{,}000$, $N = +4{,}000$, whereas a shear undergoing complete reversal from 8,000 in one direction to 8,000 opposite would be $M = +8{,}000$, $N = -8{,}000$.

The conditions subject to which a joint will permanently withstand any variations of the given kind of stress between limits M and N may be stated as a relation among M, N, S_y and S_e, where S_y is the static yield point and S_e the endurance limit for that kind of stress:

$$\frac{M + N}{2S_y} + \frac{M - N}{2S_e} = 1 \text{ or less.}$$

(See "Latest Improvements in Turbo Generators," by C. R. Soderberg, of the Westinghouse Research Laboratory, Am. Inst. Elec. Engrs., 1928.)

This means that 1 is the upper limiting value of the left-hand member, beyond which failure will ultimately occur due to fatigue. It follows that any amount by which the value is less than 1 is a measure of the margin of safety against fatigue failure. If the relation is expressed

$$\frac{M + N}{2S_y} + \frac{M - N}{2S_e} = \frac{1}{f}$$

then f is the factor of safety against fatigue failure, or the factor by which to multiply M and N to produce a condition at the danger line.

A low average value for yield point of welds in tension or compression is 32,000 per sq.in. A limited series of tests on fatigue of butt welds indicates 16,000 as a conservative figure for endurance limit under direct stress. (See article on "Strength of Butt Welds," by G. Lobo, Jr., research engineer of the Westinghouse Electric & Manufacturing Company, *Journal*, American Welding Society, April, 1929.) A far more comprehensive program of fatigue tests is now being carried on by R. E. Peterson under the direction of John M. Lessells at the Westinghouse Research Laboratory, which may lead to different figures.

According to the maximum-shear theory for ductile materials, the strength properties of weld metal in shear would be one-half the corresponding properties in direct stress. Possibly due to the fact that pure shear does not occur in welded connections of the kinds here considered, the strength properties of such welds in shear are actually greater than half of the properties in direct stress, at least in so far as static strength is concerned. It is too soon to assert that this is also true for endurance limit. For the purpose of this specification, the shear properties will be assumed at five-eighths of the direct stress values—that is, 20,000 for yield point and 10,000 for endurance limit. The yield point value is known to be conservative and the endurance limit is at worst roughly approximate.

The fatigue equation may now be written:

$$\text{Direct stress} = \frac{M + N}{64{,}000} + \frac{M - N}{32{,}000} = \frac{1}{f}$$

$$\text{Shear} = \frac{M + N}{40{,}000} + \frac{M - N}{20{,}000} = \frac{1}{f}$$

To convert these equations into practical working formulas, a value must be assigned to the safety factor f. This should be large enough to cover the multitude of anomalous items not accounted for in designing, including errors in the theory, variations in physical properties of materials, imperfections of workmanship, minor errors in design calculations, secondary and eccentric stresses, overloading of structure, and deterioration.

General practice in steel construction has furnished ample precedent for providing a safety factor of 2 or thereabout to cover such contingent items. For example, a working stress of 16,000 for tension or compression in ordinary structural steel for buildings provides a safety factor of 2 with respect to a yield point of 32,000, the yield point itself being the natural limit of safe stress in a structure where live-load variation is too small or too infrequent to cause fatigue.

Using safety factor $f = 2$, and rearranging, the equations become:

$$\text{Direct stress} = M + \tfrac{1}{2}(M - N) \leqq 16{,}000.$$

$$\text{Shear} = M + \tfrac{1}{2}(M - N) = 10{,}000.$$

or *maximum stress plus one-half range of stress equals* 16,000 *for direct stress or* 10,000 *for shear.*

The shrinkage of weld metal while cooling produces direct stresses sometimes called *residual* stresses. In so far as the test specimens which have yielded experimental data have been representative of welded connections in actual structures, residual stresses have been automatically accounted for, but it is a matter of experience that some forms and combinations of butt welds are liable to higher intensities of initial tension and compression than are the usual forms of test specimens. When such a joint is free from external stress, the system of internal stresses is in equilibrium and on the critical section consists of three or more zones alternately tensile and compressive. External tension applied to such a joint causes the initial tension zones to pass the yield point, while the average stress in the cross-section is less than the yield point. The stretching of that part of the metal which thus passes the yield point relieves it of part of its excess stress and distributes it elsewhere in the cross-section of the joint. In many cases this redistribution probably removes most or all of the initial stresses after a number of applications of loads sufficiently high to form permanent elongation of the initial tension zones; in other cases, probably owing to high values of initial stresses or to rapid application of load preventing opportunity for readjustment, there occurs a crack which may or may not spread through the entire cross-section and cause failure. A butt joint for resisting compression only is not seriously affected by initial stresses. Extensive practical use of fillet welds in framed structures, including railroad bridges, indicates plainly that initial stresses in this type of weld are generally unimportant.

Initial tension in rivets is known to be considerable, is variable and is an occasional cause of trouble when the rivets are subjected to often-repeated tensile stress. There is, however, much disagreement as to the propriety

of using rivets to withstand tension due to main stresses, even though it is generally approved practice to use them in tension under wind stresses and secondary stresses. The most commonly occurring rivet failure, to the best of the writer's belief, is tension failure in the upper rivets connecting the framing angles of railroad bridge floor stringers to floorbeams, due to secondary bending stress in the joints combined with initial tension in the rivets. There is a close analogy between rivets in tension and butt welds in tension. Initial tension, which is not well understood but which is known to vary considerably in apparently similar cases, combines with external tension and sometimes results in a broken rivet shank or a cracked weld. Pending the completion of tests now under way and others which are contemplated, it seems wise to avoid using butt welds for connecting main tension members, just as conservative practice in riveted construction avoids use of rivets in tension for main member connections.

Specification for Bridge Welding

Application

1. This specification applies to the design and execution of arc-welded connections in old or new fixed or movable bridges of structural grade medium-carbon steel or of wrought iron. It is needlessly conservative for bridges carrying infrequent traffic and for temporary structures.

Welding Process

2. This specification contemplates the use of the direct-current electric arc process.

3. Welding machines shall consist of welding generators manufactured by a reputable company expressly for arc-welding purposes, driven by electric or gasoline motors at correctly regulated speed and provided with suitable manual control for adjusting the current output and with automatic regulation to maintain constant current and arc voltage at every setting of the control.

4. Welding electrodes shall be of open hearth steel of very uniform texture, free from segregation, oxides, pipes and seams. They shall form smooth rounded non-porous globules when tested by fusing with an oxyacetylene flame, and in service they shall show good weldability without splutter in all positions. Chemical composition shall conform to the following and shall not vary materially as between one electrode and another: carbon, not over 0.18 per cent; manganese, not over 0.60 per cent; phosphorus and sulphur, not over 0.04 per cent each; silicon, not over 0.08 per cent. Permitted sizes of electrodes: $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{1}{4}$ in. diameter; maximum variation from nominal size, plus or minus 3 per cent.

5. Welding current and arc voltage:

$\frac{1}{8}$-in. electrodes,	90	to 115	amp.
$\frac{5}{32}$-in. electrodes,	140	to 175	amp.
$\frac{3}{16}$-in. electrodes,	175	to 225	amp.
$\frac{1}{4}$-in. electrodes,	300	to 375	amp.

Voltage across the arc shall be approximately 20 volts.

6. Surfaces to be welded shall be bare metal, free from paint, grease, loose scale and rust. A thin coating of linseed oil without pigment need not be removed. Any clinker or slag shall be removed from flame-cut surfaces before welding.

7. Arc length shall be the shortest the operator can hold, and in no case shall exceed the electrode diameter.

8. Penetration (depth of fusion in base metal) shall be sufficient to insure complete uninterrupted integration of weld metal with base metal.

9. Size of electrode, current and speed at which electrode passes shall be so related to thickness and arrangement of base metal parts as to avoid excessive heating of base metal or weld metal.

Operators

10. Welding operators shall be men properly trained in arc welding, experienced in welding structures and capable of making uniformly reliable butt and fillet welds in flat and vertical positions. In the absence of positive knowledge that the operators possess the necessary skill, they shall make samples in the presence of an inspector capable of judging their ability by observation and shall prepare butt-weld test specimens as prescribed by the American Welding Society, which specimens shall be tested for tensile strength and shall develop ultimate stress not less than 45,000 lb. per sq.in. average and not less than 40,000 lb. per sq.in. minimum for each operator's work. Overhead welding, if required, shall be done only by operators who can qualify for this work according to the above standards.

Inspection

11. Every layer of every weld shall be inspected for quality and every welded joint shall be inspected for agreement with drawings.

12. Inspectors shall be men properly trained and thoroughly experienced in supervising and inspecting arc welds on work requiring unquestionable reliability and shall be capable of reading and interpreting detail drawings. Mere evidence of prior employment in similar capacity shall not be sufficient basis for intrusting an inspector with final approval of welds, unless reliable testimony is included to prove that the inspector's ability to distinguish between sound and unsound welding has been established.

13. Welds built up in multiple layers shall be inspected layer by layer in the course of making; in the event of failure to inspect the inner layers of any multiple weld before the covering layers are laid on, the inspector may in his discretion inspect the inner layers by cutting out fragments at intervals.

14. Every weld shall be inspected for uniformity of surface, feather edges as indicative of thorough penetration and as distinguished from overlap, absence of clinker and discoloration characteristic of burned metal, solidity as indicated by absence of surface pores, and agreement with dimensions called for.

15. Inspectors shall make a systematic record of all welds, to insure not only that all noted faults shall be remedied and rechecked but also that every weld called for on the drawings shall be completed and shall be of full cross-section and full length. Inspectors shall report to the structural engineer any cases of welds which are materially longer or thicker than called for, because weld metal deposited where none is intended may occasionally be a menace to safety.

16. Inspectors shall employ a flashlight wherever necessary to see a weld distinctly. In any case where a weld cannot be inspected thoroughly, the facts shall be reported to the structural engineer, who shall provide for making the weld accessible to the inspector or for additional welding in a more favorable location.

17. All welds or parts of welds not passed as satisfactory shall be removed with cutting torch or chisel and replaced.

Flame-Cutting

18. Wherever bridge members, connection pieces or reinforcing material are required to be coped, trimmed, shaped or otherwise cut to permit welding, such work may be done with a gas cutting torch in the hands of a man experienced in accurate flame-cutting, except where cutting by machine tools is specified elsewhere in the bridge specifications.

19. Any necessary cutting not expressly shown on the drawings shall be referred to the structural engineer before being done. In alteration work, any field cutting of old members, connections, lacing or rivets shall be done only under the direct observation of the job superintendent, and in case of any such work not expressly shown on the drawings shall first be referred to the structural engineer.

20. In flame-cutting, care shall be taken to avoid cutting or damaging any adjoining metal which is not intended to be cut, and to avoid burning of the metal along the cut faces.

Weld Forms and Applications

21. The following weld forms may be used:

(*a*) Butt welds, conforming to any of the four types shown in Fig. 1; they shall be designated by throat dimension, type and length (for example, $\frac{1}{2}$-in. double-vee butt weld 4 in. long).

(*b*) Fillet welds, conforming to Fig. 2. They shall be designated, in accordance with prevailing usage, by leg dimension of triangular section and length (for example, $\frac{3}{4}$-in. fillet weld 6 in. long).

(*c*) Slot welds, conforming to Fig. 3. They shall be designated by throat dimension, depth and length (for example, $\frac{3}{4}$x$\frac{1}{2}$-in. slot weld 12 in. long).

22. No weld shall be shorter than $1\frac{1}{2}$ in. The minimum size for fillet welds shall be $\frac{1}{4}$ in. (throat dimension 0.18); the maximum size for fillet welds, leg dimension, shall be twice the thickness of the thinner base metal part.

23. The following applications may be made:

(*a*) Butt welds may be used to transmit direct stress (as in case 1, Fig. 4), or longitudinal shearing stress (as in case 2, Fig. 4), or a combination of the two, with or without bending or torsional moments having no component about the longitudinal axis. Butt welds shall not be used for end connections or splices of main tension members or for splices of tension flanges of girders; this restriction does not apply to brace members or to any members which are not subject to tension from live load (train or vehicle load).

(*b*) **Fillet** welds may be used to transmit longitudinal shear (as in case 3, Fig. 4) or transverse shear and direct stress (as in case 4, Fig. 4), or a combination of the two, with or without bending or torsional moments having no component about the longitudinal axis.

(*c*) Slot welds may be used to transmit longitudinal shear (as in case 5, Fig. 4) or transverse shear (as in case 6, Fig. 4), or a combination of the two, with or without bending or torsional moments having no component about the longitudinal axis.

Critical Stresses

24. The critical section of any weld shall be taken as the longitudinal section containing the throat. Its area is Throat × Length and its section modulus is Throat × Square of Length ÷ 6. Its torsional modulus is approximately the same as its section modulus, because the throat dimension is relatively small and will be considered the same.

25. In case the resultant applied stress is a central force without bending or torsion, the critical unit stress will be either direct stress or shear, determined as follows:

(*a*) Butt weld in direct stress (case 1): critical stress is direct (tension or compression) and is equal to total stress divided by critical area.

(*b*) Butt weld in longitudinal shear (case 2), or fillet weld loaded as in case 3 or case 4, or a combination of both, or slot weld loaded as in case 5 or case 6, or a combination of both: critical stress is shear and is equal to total stress divided by critical area (this is an arbitrary convention in welds involving case 4).

(*c*) Butt weld in direct stress and longitudinal shear, a combination of the loading in cases 1 and 2: critical stress is either unit shear, equal to total shear divided by critical area, or unit resultant stress, equal to total oblique stress divided by critical area and arbitrarily considered direct stress; the critical stress is whichever one of these two unit stresses requires the larger section according to paragraph 29.

26. In case applied stress resolves into a central force plus bending or torsion, the extreme fiber stress due to bending and the extreme shear due to torsion at each end of the critical section will be determined by dividing each moment by the section modulus of the critical section; the maximum direct stress or shear thus determined will be combined with the unit stresses due to the central force per paragraph 25, the latter being considered uniformly distributed. The critical stress will then be either the maximum combined unit shear or the maximum combined unit resultant stress (arbitrarily considered direct stress).

27. Any reinforcement of a weld, by which is meant a rounding or building up of the exposed face beyond the theoretical boundary, shall be disregarded in calculating strength. Reinforcement of fillet welds shall not be permitted beyond ordinary irregularity of surface.

Design of Welds

28. Welds shall be designed in accordance with the limitations of paragraphs 21 to 23 inclusive and with critical area (throat section) sufficient to satisfy the requirements of paragraph 29.

29. Let M represent the maximum value of critical stress occurring in the weld due to any combination of external loads acting on the structure, and let $M - N$ represent the extreme range in value of critical stress due to variation of external loads. The critical area shall be made large enough to satisfy the following requirements:

For direct stress, $M + \frac{1}{2}(M-N)$ shall not exceed 16,000 lb. per sq.in.
For shear, $M + \frac{1}{2}(M-N)$ shall not exceed 10,000 lb. per sq.in.

These requirements may be expressed in words as follows:

The maximum value of critical stress on the throat section of a weld, plus one-half the extreme range in value of critical stress due to variation of loading, shall not exceed 16,000 lb. per sq.in. in case of direct stress or 10,000 lb. per sq.in. in case of shear.

Loads

30. The stresses to be transmitted by the welded connections shall be determined by analysis of the structure, and shall include the effects of dead load, live load, impact, centrifugal force (if any), wind load and other lateral forces, braking and other longitudinal forces and (in the case of movable bridges) all loads sustained during opening and closing.

These several loads shall be assumed at the same values used in designing the bridge members, provided that allowance for impact shall be not less than that given by the formula

$$\textit{Live Loads} \times \frac{300}{300 + \frac{L^2}{100}}$$

where L is length of effectively loaded span in feet, for live load due to steam trains, and not less than half the amount given by that formula for live load due to electric trains. For determining maximum values of stresses transmitted by connections and extreme ranges of same, all possible combinations of simultaneous loads shall be considered, except that combinations including live load together with lateral or longitudinal forces may be considered reduced 20 per cent in value.

Full allowance shall be made for any bending or torsional moments in the connections due to eccentric intersections of bridge members or to eccentricity in the design of the connections.

Full allowance shall be made for secondary bending moments in the connections induced by deflection of stringers and floorbeams.

Allowance need not be made for other secondary stresses due to deformation under load or due to temperature strains in bridge members, unless they are sufficient to increase the maximum critical stress in any weld more than one-third, in which case the critical stress, including said secondary stress, may be considered reduced 25 per cent in value.

Connection Members

31. Connection members such as gusset plates, bars, angles, channels and the like, used with welds to form joints between bridge members, shall be designed to transmit the calculated stresses without exceeding the working stresses permitted in the bridge members.

Nominal Stresses

32. Connections for bracing members whose design is not determined by calculated stresses shall be adequate to develop the full strength of the members.

Built-Up Members

33. Welds used for connecting the component parts of built-up members shall be proportioned for any calculable stresses to be transmitted, but the clear distance between welds in line and between lines of welds shall not exceed the corresponding spaces which would be permissible for rivets if used for the same purpose.

34. Cover plates of truss chords and plate girders shall be at least 1 in. wider or narrower than the flanges and shall be connected to the flanges by fillet welds at both edges (and slot welds if desired or if necessary), arranged to develop the cover's proportionate share of the flange stress within a distance from each end not exceeding 40 times the cover thickness and not exceeding the distance to end of the next cover if any. Any compression cover plate having width-to-thickness ratio exceeding 30 shall be connected to the flange by at least one line of slot welds in addition to two lines of fillets, the limit of unsupported width to be 30 times the thickness.

Continuity of Stringers

35. Floor stringers may be made continuous by providing connections capable of resisting the negative moments at supports; in such cases the bending moments and floorbeam reactions shall be determined in accordance with continuous-beam theory. If continuity is not developed by the connections, stringers shall not be welded directly to the supporting members but shall be supported by side framing angles or seats or other means permitting deflection of the stringers without excessive secondary bending in the connections.

Arrangement of Welds

36. Fillet welds shall not be used singly; at every joint where they occur they shall be arranged in groups of two or more in such manner as to prevent occurrence of bending moments in individual welds about their longitudinal axes and to prevent indeterminate twisting moments due to eccentricity.

37. No arbitrary minimum spacing for parallel slot welds is prescribed, but the base metal of the slotted part between welds shall have sufficient section to sustain the stresses transferred by the welds.

Supplementary Comment

Floor stringers may advantageously be made continuous, with some saving in weight due to reduction in maximum bending moments, and with positive protection against fatigue failure in the connections by elimination of the angular motion which occurs at the ends of simply supported or partly fixed beams.

Plate girders and built-up chords may economically be made of plate material without angles, owing to the facility with which plates meeting at right angles may be con-

nected by fillet welds. The moment of inertia per square inch of cross-section is generally materially increased by omitting angles, an important advantage in case of flexural members.

Holes for bolts or rivets are not needed, except such few as may be required for erection purposes; it is never necessary to make any deduction for cross-section of holes in a tension member or tension flange, because holes for erection bolts need not occur in a critical section.

Gusset plates and other connection material may be avoided entirely at many joints, and, where needed, may be made much smaller in area than would be required for riveted connections, owing to the relatively high concentration of strength possible in welded connections. Small gussets at truss joints mean relative flexibility of framework and correspondingly low secondary stresses.

Slot welds are most advantageously placed parallel with stress in a majority of cases. In this position they cause more favorable distribution of stresses in the gussets or other slotted parts than in a transverse or diagonal position.

Butt welds, especially thick ones, are usually uneconomical, mainly because they require accurate lengths and beveling of the ends of the members, but partly because they require special technique and are expensive to inspect. They are sometimes useful because they are very compact and avoid the use of connection parts.

Generally, fillet welds cost less than slot welds for equal total strength, but in cases of very large total stresses the concentration of strength effected by slot welds is frequently necessary to keep the connections within reasonable bounds of size and weight. The saving in weight of gusset plates or other connection material due to slot welds may more than offset the extra cost of the welding.

Fillet welds of small throat dimension require less weld metal than thick fillets of equivalent total strength, because the volume per unit length is equal to the square of the throat dimension, whereas the strength per unit length is proportional to the throat dimension. There seems to be little advantage in using welds smaller than the $\frac{1}{4}$-in. size, because the electrode size and current have to be reduced, and this reduces the rate at which weld metal can be deposited. On the other hand, fillets larger than $\frac{3}{4}$ in. are conspicuously uneconomical because of the large volume per unit of strength.

Overhead welding is very slow and should be avoided if possible, even at considerable sacrifice in extra welding or extra connection material. It is frequently unavoidable in reinforcing old bridges.

Acknowledgment

Valuable technical criticism has been furnished by A. M. Candy, W. W. Reddie, J. M. Lessells and C. H. Jennings, all of the Westinghouse Electric & Manufacturing Company.

Sidewalk Traffic Conditions and Obstacles Shown by Study

Pedestrian Speed Restricted if Density Exceeds 300 Per Foot Width Per Hour—Open Elevator Worst Obstruction

By Charles S. Moore
San Francisco, Calif.

Sidewalk traffic congestion in metropolitan business districts is rapidly becoming a major city planning problem. Adequate solution of this problem in the older established districts is often impracticable because of difficulty in modifying existing sidewalk design, leaving removal of sidewalk obstructions that tend to impede pedestrian traffic as the most feasible way of obtaining some measure of relief. On the other hand, newer districts can study the possibility of designing sidewalks to care for the estimated future traffic. Beginning with some figures obtained by the writer during the San Francisco traffic survey under direction of Prof. Miller McClintock, the following data on sidewalk traffic conditions were gathered in various California cities as a part of recent thesis work at the University of California.

Ideal sidewalk traffic conditions would be realized if each person were permitted to travel in whatever manner he wished unhampered by other pedestrians. Such conditions are scarcely obtainable in a business district during any daylight hour, and the real problem of sidewalk traffic is caused by the extreme peak loads that occur at the morning and evening rush periods of the day. This peak load to be accommodated also varies according to the hour of the day, the weather and the type of district.

Sidewalk traffic shows certain definite characteristics in regard to speed and volume. Variations in pedestrian speed throughout a normal day in the financial district of San Francisco are shown by Fig. 1. From 8:30 to 10 a.m. the majority of the traffic was traveling in one direction, while in the remaining two hours before noon the traffic was approximately equal in both directions. During the noon hour the sidewalk was filled with a slowly moving crowd due to congestion and the leisurely action of the pedestrians. In the afternoon, travel was

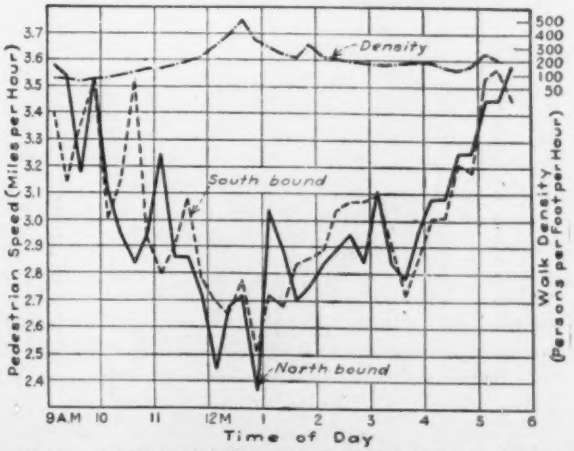


FIG. 1—HOURLY VARIATION OF PEDESTRIAN SPEED IN FINANCIAL DISTRICT

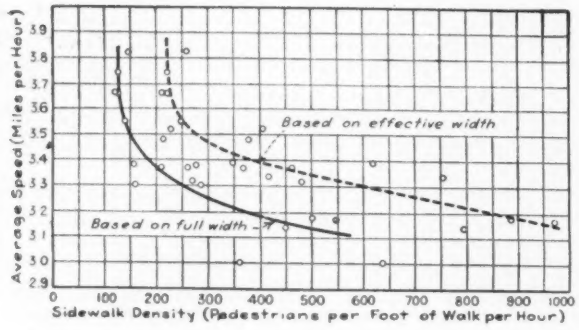

Average Speed (Miles per Hour)
Based on effective width
Based on full width
Sidewalk Density (Pedestrians per Foot of Walk per Hour)

FIG. 2—RELATION OF PEDESTRIAN SPEED TO TRAFFIC DENSITY IN FINANCIAL DISTRICT

evenly divided until 4:30 o'clock, when the peak load of the morning was reversed.

Statistics gathered during various conditions of sidewalk densities show a definite relation between the number of pedestrians and their speed (see Fig. 2). The solid line represents values based on nominal sidewalk-width; the dotted line is based on the effective width, considering obstructions. An elevator cover left open all day long reduced the width of the sidewalk at this point 50 per cent. The density of sidewalk traffic does not affect the speed of pedestrians noticeably until it reaches a value of 300 persons per foot of walk width per hour. Above this value increase in density causes a definite decrease in speed until a density of 500 is reached, above which value sidewalk traffic will be seriously impeded.

A similar study made in a typical shopping district is shown by Figs. 3 and 4. Observations indicated that a lower rate of speed is maintained in this type of district for a longer period of the day. A large part of the sidewalk congestion is due to shoppers loitering to inspect wares in shop windows, resulting in decreasing the effective sidewalk width. The relation between sidewalk density and the speed of pedestrians, however, shows a curve similar to the one in Fig. 2, indicating that approximately the same relation between speed and density will be found regardless of the nature of sidewalk traffic.

Variation of traffic speeds and peak load may be very unusual in special cases. For example, a traffic count taken at the main entrance of a large university showed high hourly peaks due to students hurrying to and from classes.

From these observations the conclusion is drawn that sidewalks which provide for a density of not more than

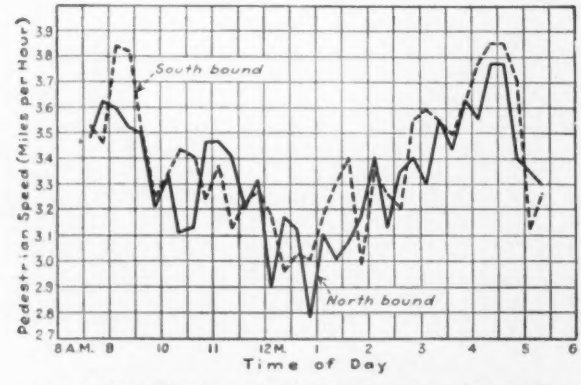


FIG. 3—HOURLY VARIATION OF PEDESTRIAN SPEED IN SHOPPING DISTRICT

Note the retarding effect of increased traffic density.

SIDEWALK OBSTRUCTIONS IN SAN FRANCISCO BUSINESS DISTRICT

Obstruction	Number	Reduction in Sidewalk Width (Aver., Per Cent)
Open elevator covers	142	52.9
Flower stands	14	41.5
Merchandise	42	37.2
Bicycle stands	10	34.6
Advertising signs	46	27.5
Flower pots	41	26.2
Fire plugs	225	24.9
Trash boxes	130	23.7
News stands	158	23.4
Fire and police phones	34	23.4
Mail boxes	111	23.2
Electroliers and trolley poles	561	22.8
Street markets	70	21.7
Shoeshine stands	18	20.3
Automatic signals	33	18.3
Parking signs	437	17.7
Barber poles	13	15.7

500 persons per foot of walk per hour will be ample. Although the sidewalks of Market St. in San Francisco have a width of 22 ft., the business district as a whole is provided with narrow walks, averaging from 14 to 16 ft wide.

Sidewalk traffic in residential districts was investigated and it was found that about 40 per cent of the pedestrians in such districts walk in pairs. If residential side-

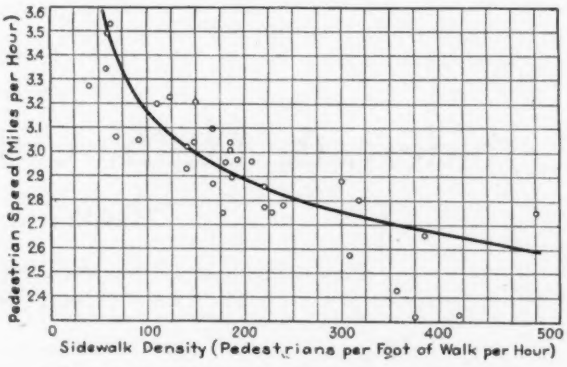


FIG. 4—RELATION OF PEDESTRIAN SPEED TO TRAFFIC DENSITY IN SHOPPING DISTRICT

walks are to provide adequately for the convenience of this 40 per cent of the traffic, a width of 6 ft. will be required to permit the unrestricted passing of pedestrians in pairs. The cities of Berkeley and Seattle have adopted a standard sidewalk width of 6 ft. for residential districts, and it is believed that such a minimum width should be required.

The right of a city to control and prohibit the private occupation of public sidewalks is obvious and yet surveys showed serious obstructions to sidewalk traffic, both from public and from private encroachments. A survey of the San Francisco central business district showed 2,658 separate sidewalk obstructions. The most important and frequent of these are listed in the accompanying table, together with the width of sidewalk blocked by the obstruction.

It is significant that the six obstructions occupying the greatest sidewalk width are unnecessary and are purely private ventures. It was found that 33.9 per cent of all sidewalk elevator covers were left open and that 85 per cent of these were unattended. Many of them remain open throughout the entire day with merchandise piled on the sidewalks near by. In one case a newsstand and an open elevator cover reduced a 14-ft. sidewalk to an effective width of 4 ft., leaving barely room for three

people to walk abreast. Among the obstructions of a public nature, fire plugs are the most numerous and could be installed in pits with flush covers where sidewalk space is at a premium. Trash boxes could be better located, and mail boxes could be recessed in buildings after the European manner.

Immediate relief from sidewalk congestion can most easily be obtained by the removal of obstructions. In most cases the removal of existing obstacles would be equal to widening the sidewalk 20 to 25 per cent. Congestion in shopping districts can be relieved by the use of semi-arcaded and arcade sidewalks for shop window displays. This idea is used comparatively little in the United States but may be resorted to more generally as sidewalk conditions become worse. Grade separations at crossings are used to some extent and if properly located and constructed are effective in affording relief at congested points.

Fire Resistance of Hollow Load-Bearing Wall Tile

Comprehensive Tests on the Safe and Economical Use of This Material

THE results of comprehensive tests to determine the fire-resistance value of hollow clay wall tile conducted in co-operation with the Hollow Building Tile Association are reported in the January number of the Bureau of Standards *Journal of Research*.

While hollow clay tile has been used in this country for about 50 years in floor arches, partitions and as protection for structural members, only during the past twenty years has it been extensively applied for load-bearing purposes in walls. The safe and economical use of this material, as of other masonry materials, requires knowledge of its strength and fire resistance under conditions imposed by severe fires. Fire resistance of walls is rated mainly on ability to keep the temperatures of the side away from the fire to a point where they will not ignite combustible materials in contact with the wall. Ability to carry load throughout the fire and to withstand the impact from hose streams are also necessary conditions. The amount of damage incurred and methods of making repairs are likewise of interest.

The work reported in the paper consists in the main of three series of fire tests of wall construction built of tile of representative designs and clay materials. The first tests were made on wall sections 1 ft. wide and 6 ft. high that were subjected to fire on one side while under working load, the main object of the tests being to determine how the fire exposure affects the individual tile unit. This was found to vary with the type of clay used, hardness of burning and design of the unit, from minor cracking of a few of the units in the specimen, to failure under load a little after two hours.

The second group of tests was with wall specimens 4 ft. wide and 4 ft. high tested exposed to fire on one side, under load or restrained within the containing frames, and was made to study the effect of changes in design of the unit and in the constituents and preparation of the clay.

Addition of ground burned clay (grog) to the raw clay in amounts up to 2 per cent was found to be without effect, but higher percentages increased the fire damage, apparently because of initial shrinkage cracks radiating from the grog particles. Additions of sawdust to the raw clay in amounts up to 15 per cent by volume decreased the tendency to cracking when exposed to fire without seriously decreasing the normal strength of the tile. Fine grinding and greater amount of pugging of the raw clay increased the strength of the tile and consequently its load-carrying ability when exposed to fire.

Of modifications in the design of the unit, one with double outside shells improved the fire resistance for all but very dense tile in confining the cracking mainly to an outer thin shell. Increased shell thickness was also found to decrease the fire effects, as also fillets of up to ¼ in. radius at the junctions of shells and webs.

The final series consisted of 167 fire endurance tests and four fire and water tests of typical wall constructions, 71 of which were made with walls between 10 and 11 ft. high and 8 to 15 ft. long. The thickness ranged from 8 to 16 in., and plaster, stucco or brick facing was applied on a number of the walls. The walls were subjected to constant applied loads of 70 to 120 lb. per sq.in. during the fire test, were restrained within the containing frames or were tested unrestrained, the latter condition being representative of walls in low buildings or the upper story walls of higher buildings. The results are summarized as fire-resistance periods, which are determined by the time the walls sustained load under fire exposure and prevented the average temperature rise on the unexposed side from exceeding 250 deg. F., or the maximum rise at any point where temperature measurements are taken from exceeding 325 deg. F. Freedom from cracks or openings large enough to transmit flame or ignite combustible materials is also required both in fire endurance tests and fire and water tests.

The final grouping of test results is in three classes, determined by the design of the tile. Fire-resistance periods are given for 8-, 12- and 16-in. walls in each class, the values varying with the thickness and design from 1¾ to 11 hours for unplastered walls and from 4 to 15 hours for walls plastered on both sides. Periods are also given for walls assumed to have combustible members projecting into them 4 in. from the unexposed side, this being determined by the time required for temperatures high enough to ignite wood to obtain at the given depth in the wall. Fire-resistance periods for this condition ranged from one hour with 8-in. unplastered walls to ten hours with 16-in. plastered walls built of tile of the designs giving the highest results.

Gypsum and portland cement plasters applied on one or both sides of the wall constructions not only increased their fire-resistance periods but that on the side exposed to fire also appreciably decreased the fire effects on individual units and the construction generally. Where applied on split furring tile, plaster was found to prevent all fire damage to the load-bearing tile in fire tests lasting as long as six hours.

New Welland Canal Lock Nearly Completed

Announcement has been made by the chief engineer of the Canadian Department of Railways and Canals that the lock at the Port Colbourne-Lake Erie end of the new Welland Canal will be ready for operation in the near future. This lock is 1,380 ft. long, with a depth of 30 ft. of water. It will be operated in connection with the old canal.

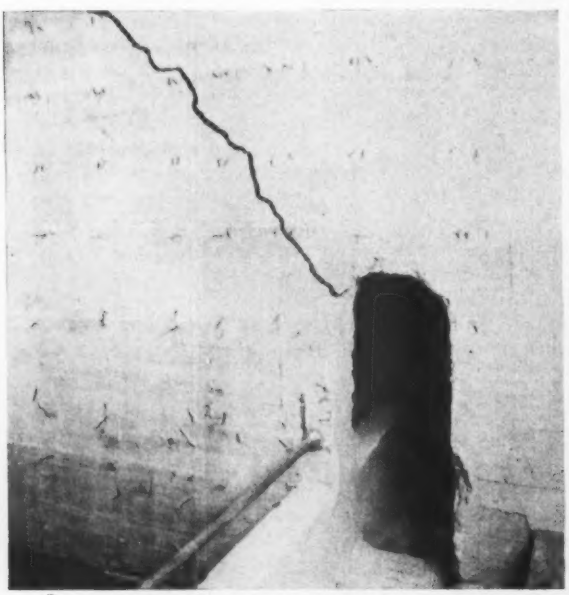
Concrete Girder Fails as Doorway Is Cut Through Web

Opening Made Without Engineering Advice Proves Costly—Cracks Show Diagonal Tension Failure—Temporary Repairs in 42 Hours

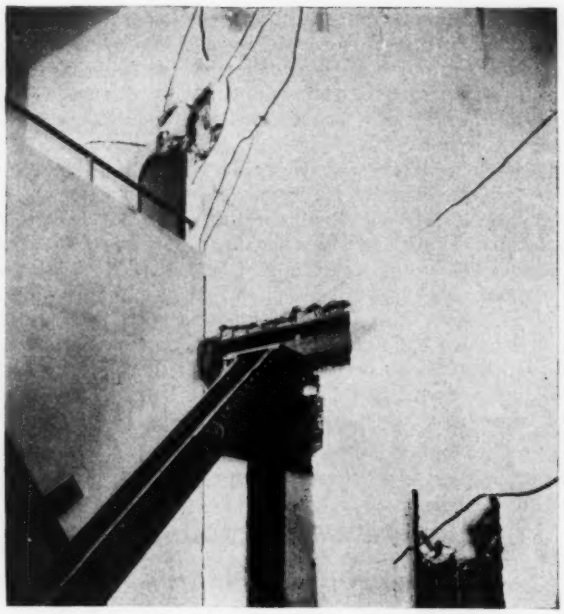
DESIRE for a convenient passage between two spectators' galleries in the Elks' Club of Los Angeles caused a doorway to be cut through what was thought to be a partition wall but which later proved to be the web of a 60-ft. concrete roof girder. Incipient failure of the girder followed and the emergency repairs to prevent serious disaster and the permanent reconstruction required by this accident brought the total cost of the doorway to about $10,000.

The roof girder, 60 ft. long and 15 ft. deep, is inclosed in the upper part of a partition wall between two hand-ball courts of the club. The two spectators' galleries at the end of the courts were separated by this wall, which, at the height of the gallery, incloses the web of the girder. The inconvenience of not being able to pass directly from one gallery to the other resulted in a decision by an employee to cut a passage through the wall. This was done on the assumption that merely a partition wall was being cut and without any realization that one of the main structural members of the building was involved.

Within a few days large cracks began to appear in the plaster and engineers were consulted. It was found that the girder had been weakened not only by the opening cut through the web close to one of the supports but in addition by the cutting of three $\frac{5}{8}$-in. square stirrups and the exposure of the bottom bars at the threshold of the door. Stripping the plaster showed that the beam had failed in diagonal tension, a large crack being opened from the upper part of the door through to the top of the girder. This failure resulted in placing



DOORWAY CUTS THREE STIRRUPS IN GIRDER
Definite failure in diagonal tension shown by long crack indicated by painted line.



TEMPORARY SUPPORT FOR GIRDER
Cracks in the plaster are indicated by painted lines.

an average shearing stress of approximately 175 lb. per sq.in. on a section which was virtually unreinforced because of the cutting of the stirrups.

The stem of the girder is 18 in. wide and 180 in. deep, reinforced with fifteen $1\frac{1}{4}$-in. square bars at the bottom and twelve $1\frac{1}{4}$-in. square bars at the top, and had $\frac{5}{8}$-in. square U stirrups in each end. The span is 60 ft. 2 in., and the maximum computed moment 4,750,000 ft.-lb. with a shear of 314,000 lb. at the support. About 85 per cent of this shear and moment results from dead load. The gallery rail consists of a reinforced-concrete beam 8 in. thick and 36 in. deep, framing into the girder at the doorway.

The factors which assisted in preventing total collapse were: (1) the supporting effect of a 6-in. hollow-tile wall under the gallery rail; (2) the effect of the fifteen $1\frac{1}{4}$-in. square bars in the bottom of the girder, and (3) the cantilever effect of the concrete roof joists resting on the girder.

Emergency repairs required speed and care in avoiding jars and bumps. Shoring the girder from the floor below was impracticable, due to the size of the beams.

The temporary supporting scheme adopted was to carry the end of the girder on a steel A-frame, which in turn rested on steel H-sections cantilevered out from the tops of columns that ended on the floor level of the courts. The steelwork, including some pieces weighing more than 1,500 lb., had to be brought in through a small fire escape door and cautiously erected by hand. The temporary repairs were completed in 42 hours from the time of starting.

Permanent repairs were made by erecting two steel trusses, one on each side of the concrete girder. These trusses were supported on the two ends of the girder by steel slabs placed over the top, holes being punched through the roof slab and hangers extending down to the end of the trusses. The concrete girder was then picked up and suspended on the lower chord panel points.

The repair work was carried out by Oliver G. Bowen, consulting engineer, Los Angeles.

Landing Bridge and Fenders, Milwaukee Municipal Car Ferry

Municipal Car-Ferry Terminal for Harbor at Milwaukee, Wis.

City Builds New Slip With Landing Bridge and Railway Freight Yard to Serve Cross-Lake Ferry Steamers—Treated Timber Used for Fenders and Landing Bridge Deck—Second Slip to Be Built

CAR-FERRY business is so important a part of the harbor traffic of Milwaukee that a municipal car-ferry slip with adjoining car storage yard has been provided for in the city's harbor development plans and is now being built. Its location, on the west side of Jones Island, on the Kinnickinnic River, is in quiet water but only a short distance from the open lake. It is more convenient than the old slips farther up the river and has the advantage of being below all the city bridges and having better rail connections and yard capacity.

At present the Pere Marquette Railroad operates a line of boats to Ludington, Mich., and the Grand Trunk Railway has a line to Grand Haven, Mich. The former road will use the new facilities, but the latter will continue at its old location for the present. Railroad service will be provided at first by the Chicago & Northwestern Railway, but arrangements have been made whereby the Chicago, Milwaukee, St. Paul & Pacific Railroad will also obtain access to the terminal. At the boat yard, eastbound cars are held for the steamers and westbound cars are placed ready to be taken away by the railroads. Two slips and boat yards are provided for in the plans, as shown in Fig. 1, but only one slip and yard are being constructed at this time.

Slip and Fenders—For the car-ferry, the slip, with 25 ft. of water, is of the usual type, having pile and timber fenders approximating in plan the outline of the stern of the boat, which is thus held in position laterally at the landing apron or bridge, as shown in Fig. 2. These fenders consist of three rows of piles with lines of waling timbers between them and on each side (Fig. 3). In view of the heavy blows and pressures which may be exerted by the boats coming into the slip, these fenders are designed for flexibility as well as strength. Thus the wales are built up of layers of 4x12-in. planks, instead of being solid timbers. On the front of the fender, the wales are closely spaced

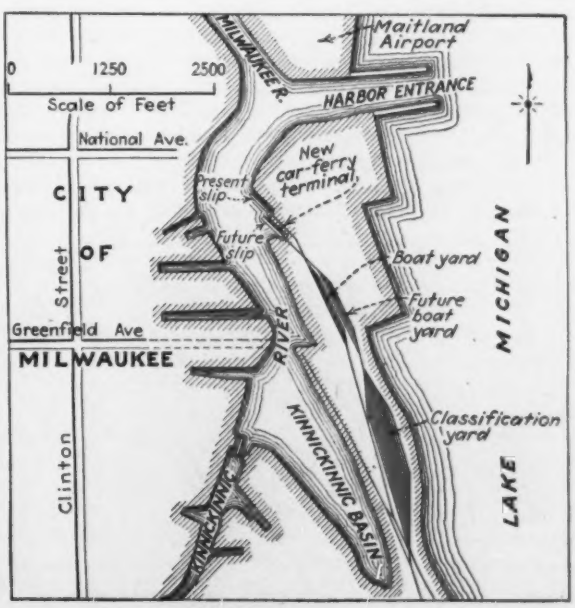


FIG. 1—CAR-FERRY TERMINAL AT MILWAUKEE

and each consists of two planks. They are faced with vertical timbers 6x8 in., having steel rails fitted between them to prevent abrasion, the rail heads projecting about ¼ in. beyond the timbers. Between the rows of piles and at the rear the wales are built up of three planks. Each front wale is bolted to every pile, and at each line of rear wales is a 1-in. through bolt or tie rod.

The north fender has an extension approximately 180 ft. long, against which the side of the boat rests. It is composed of two rows of piles and its boat side is provided with the same construction of wales and protecting timbers as described above. At its outer end this fender wall is protected by a cluster of 81 piles tightly wrapped with steel cable. Approximately 80 ft. west of this pile cluster is a large anchor pier, so designed that the car ferries may pivot about this pier when berthing, as the boats have to turn and back into the slip, since cars are moved on and off at the stern. The south fender also acts as a partial support to a tower with passenger landing platform reached by steps, as all passenger accommodations are on the upper decks of the boats and are thus clear of the cars and tracks on the main decks. An anchor pier similar to the one described above protects the outboard end of the south fender and will also offer protection to the second slip when that slip is constructed.

The anchor piers (Fig. 4) are reinforced-concrete structures 17 ft. high built upon closely spaced piles. At the bottom is a 4½-ft. slab in which the pile heads are embedded. The walls are about 3 ft. thick, but are increased to 8 ft. at the side against which the ships bear in turning. An 8-in. slab forms the top, and cross-walls 2 ft. thick divide the interior into compartments. To protect the concrete from the pressure and grinding action of the ships, these piers are faced with vertical timbers and steel rails, in the same way as the fenders. The wales, cut to fit the curve of the piers, are creosoted after framing and are attached to projecting anchor bars by vertical bolts. Snubbing posts for the ships' cables are mounted on top of the piers.

Filled ground forming the approach to the slip is retained by bulkheads composed of a row of 80-ft. creosoted piles spaced 3 ft. c. to c. and backed by triple-lap sheet piling of 3x12-in. creosoted planks. Each round pile has a 1½-in. rod extending 30 ft. to a 12x12-in. anchor timber behind a row of anchor piles, which piles in turn are tied in similar manner to a second row of anchor piles 25 ft. further back. These anchor piles, 70 ft. long and untreated, are spaced 3 ft. apart in the first row and 4½ ft. in the second row.

The piling is Southern pine and the other timber is Douglas fir, treated, except as noted, by the empty-cell process with a final retention of 10 lb. of coal-tar creosote per cubic foot of timber.

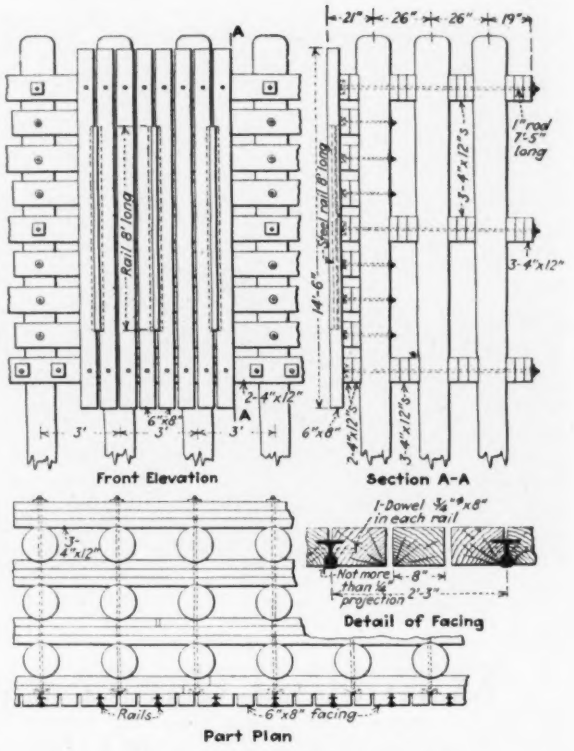


FIG. 3—FENDER CONSTRUCTION

Landing Apron—An adjustable steel bridge or landing apron 81 ft. 3 in. long connects the shore tracks with the deck of the steamer, as shown in Fig. 5. It is composed of five plate girders, each hinged at the shore end to a trunnion pin in pedestals on the timber foundation, and all connected by a transverse girder framed between their webs and extending beyond the outer girders. This transverse girder, 20 ft. 6 in. from the outboard end of the apron, is suspended by hangers from counterweighted rocking beams mounted on steel towers located on each side of the apron and supported by concrete slabs on piling. These beams are diagonal to the center line of the slip, so that their counterweighted ends are clear of the apron and fenders.

The longitudinal girders (Fig. 6) are 72½ in. deep; their bottom chords have no flange angles, but consist of three pairs of reinforcing side plates. Forged eyes on the shore end of each web carry 6-in. trunnion pins

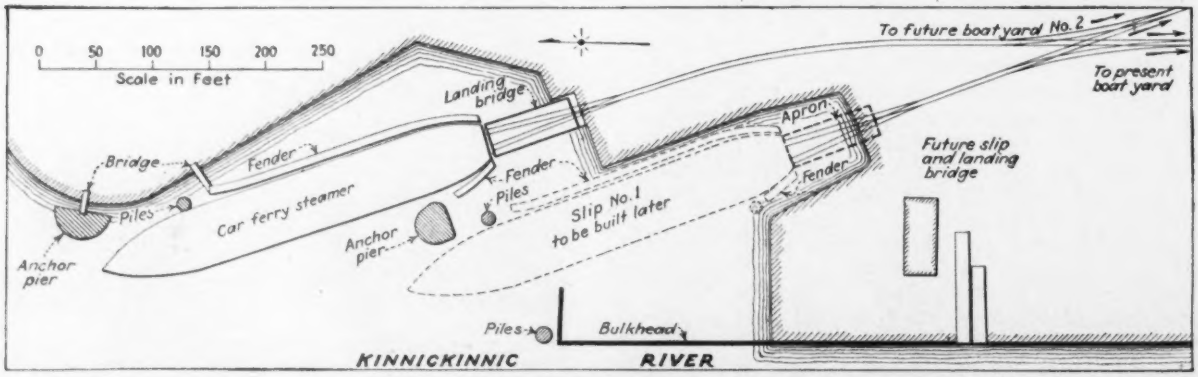


FIG. 2—SLIPS FOR CAR-FERRY STEAMERS

33 in. long, having bearings 10¾ in. long in the pedestals on the abutment. The transom girder, also shown in Fig. 6, has a 7-ft. web plate in lengths of 64 in., with spaces between them to admit the webs of the longitudinal girders, to which they are connected by heavy angles. The corners of the web plates of the transom girder are cut away to clear the longitudinal chords. For the transom girder, the chords are pairs of angles with vertical legs upstanding, so as to form a T-section. The bottom chord passes under the longitudinal girders and carries curved bearing plates upon which the latter girders are seated. Lateral bracing is fitted between the longitudinal girders, in the plane of the top chord. Each of the end panels of the transom has two webs 30 in. apart, forming a box section in which is fitted the pin for the hanger. These hangers are pairs of bars threaded at the ends for turnbuckles connecting with forged eyes for the

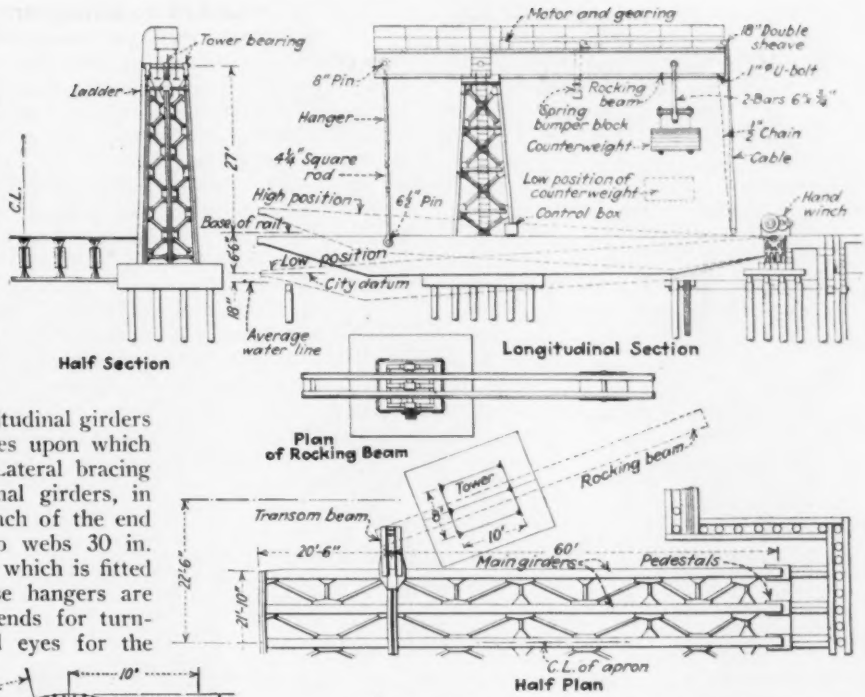


FIG. 5—LANDING BRIDGE FOR CAR FERRY

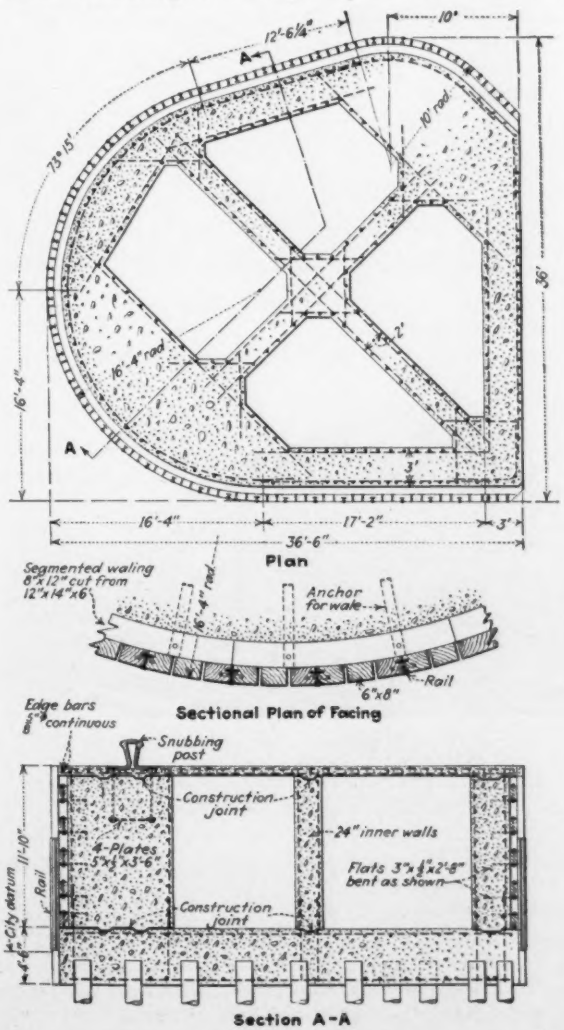


FIG. 4—CONCRETE ANCHOR PIER

8-in. pin in the rocking beam and the 6½-in. pin in the transom girder.

The rocking beam, 54 ft. 8 in. long, is composed of two 54-in. girders 3 ft. apart and carrying a 9-in. pivot pin, 8-in. hanger pin at the outboard end and 6¾-in. counterweight pin at the shore end. The pin holes are reinforced by steel castings. Along the top of the beam is a hand rail for convenience in inspection and lubrication. The steel towers supporting these beams are 27 ft. 9 in. high. Counterweights consist of cast-iron slabs 7½x4½ ft. and 8 to 1 in. thick, weighing 10,125 to 1,266 lb. each, with a normal total load of 53,158 lb., subject to adjustment. The thinner top plates are in halves for convenience in removal and replacement, as required.

Adjustment of the outboard end of the apron to the varying levels of the ship's deck is effected by means of a cable on a motor-driven drum and led through a sheave on a concrete block at the dock level. The primary operating mechanism includes a motor and geared drum seated on the top of each rocking beam and fitted with a limit device; it provides for a maximum variation of 10 ft. at the outboard end of the apron. An auxiliary operating device consists of a ½-in. chain attached to the shore end of the rocking beam and led through a sheave on the dock to a hand winch.

The deck construction consists of 6x8-in. treated ties, 2 in. apart, laid across the girders and covered with a sub-floor of 3x12-in. treated planks laid diagonally. On these is the wearing floor of 3x12-in. untreated planks, laid transversely. Two tracks from the approach intersect at the heel of the apron and diverge with split switches to connect with the four tracks on the boat. The tracks are laid with 90-lb. rails. To allow for vertical radial motion as the apron is raised or lowered, the ends of the deck rails and shore rails are about 2 in. apart and rest on a crowned bearing plate. A cast-steel bar bolted against the shore rail projects beyond the plate and has its top curved so as to carry car wheels

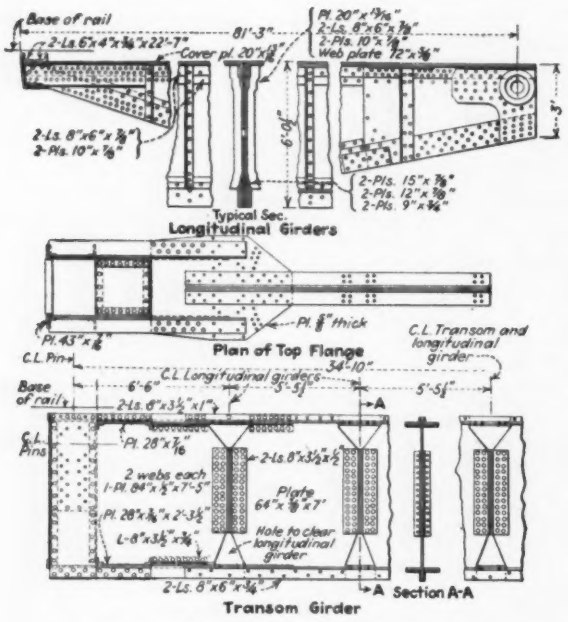


FIG. 6—GIRDERS OF LANDING BRIDGE

across the 2-in. gap and land them on the apron rails. This device is shown in Fig. 7.

Terminal Yards—The boat yard (Fig. 1), to be used in connection with the slip now under construction, consists of five tracks and is located immediately back of the shore end of the apron. The second yard will be built when the second slip is built. Of the five tracks, one is to be used as a runaround track, two for cars removed from the car ferry and two for cars to be placed upon the car ferry. The minimum length of track will accommodate sixteen cars in the clear. South of the boat yard is a classification yard with a standing capacity of 197 cars on eleven tracks. This yard is capable of extension at the southerly end and to the east, if it should prove to be necessary for future development.

The boat yard layout in connection with the classification yard will provide facilities for rapid handling of cars from and to the ferryboats. Each boat has four tracks. In operation, the switch engine will take cars from tracks 1 and 3 on the boat and place them on one of the tracks in the boat yard. Then it will push the cars for shipment onto the ferry, after which it will take the cars from tracks 2 and 4 on the boat and repeat the operation. The classification yard will

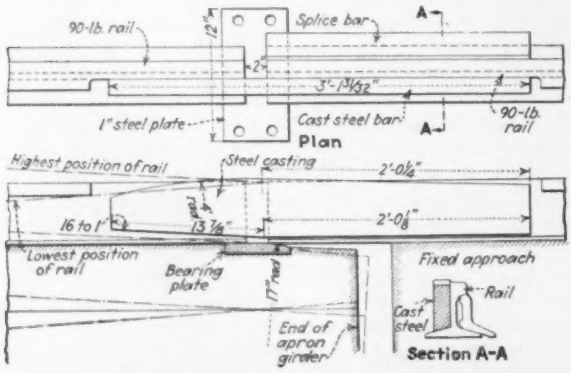


FIG. 7—RAIL CONNECTION AT LANDING BRIDGE

be used for classifying cars according to weight preparatory to placing them in the boat yard to await movement onto ferries, and also to classify cars taken from the ferries for distribution inland. For the yard tracks, new 90-lb. rails are laid on treated red oak ties with washed gravel ballast. All the turnouts in the yard have No. 8 frogs.

Designers and Builders—This municipal car-ferry terminal was designed by C. U. Smith, harbor terminal director for the Board of Harbor Commissioners, Milwaukee, Wis., with F. A. Kaiser, harbor engineer, and G. W. Lewis, assistant railroad engineer, in charge of the construction. Trackwork in the yards was done by the W. H. Knapp Company, Inc. The contractors for the ferry slip include the Edward E. Gillen Company, for the marine work; J. G. Theilacker for the transfer bridge or apron and its operating machinery (the American Bridge Company fabricating the steelwork), and the Schoonmaker Construction Company for the deck and special trackwork on the transfer bridge.

High-Capacity Dynamometer Car for Northern Pacific Ry.

Largest Car of This Type Ever Built—Chart of Locomotive Tests Records Various Pressures and Functions

FOR efficiency tests on large freight locomotives, and particularly on a new design of four-cylinder Mallet simple engine of 153,400 lb. tractive effort, the Northern Pacific Railway has built at its shops what is thought to be the largest dynamometer car in the world. This car (Fig. 1), 70 ft. long and weighing 75 tons, is equipped for measuring and recording drawbar pull up to 250,000 lb. and will measure and record buffing pressure or shock up to 1,250,000 lb.

The car is of steel construction throughout and is

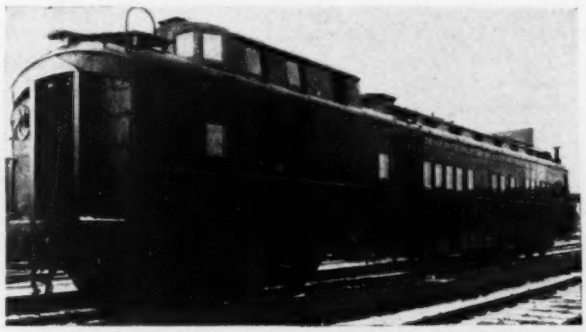


FIG. 1—DYNAMOMETER CAR, NORTHERN PACIFIC RAILWAY

This car, besides carrying the various measuring instruments, has accommodations for the crew, with kitchen, berths and even bathing facilities.

mounted on six-wheel trucks having cast-steel frames and 36-in. steel wheels. Clasp brakes are fitted to all wheels except those on the rear axle of the front truck, from which the recording chart is driven by gears. In the rear half of the car is provided accommodation for the crew, including kitchen, berths, bathroom and heating and lighting equipment. There is also a workroom, having desk and drafting table with paper rolls for the

record charts. About 6 ft. from the forward end of the car is a raised portion or cupola 12 ft. long in which is the chronograph or recording chart apparatus and from which the observers have a good view so as to note mileposts and other points. Its floor is 3½ ft. above that of the body of the car.

Traction and buffing stresses are taken by the weighing head, which is at the forward end and bolted to the underframe of the car. It is of the diaphragm type, with the piston for traction or drawbar pull (100 sq.in. area) at the rear and buffing piston (200 sq.in.) at the

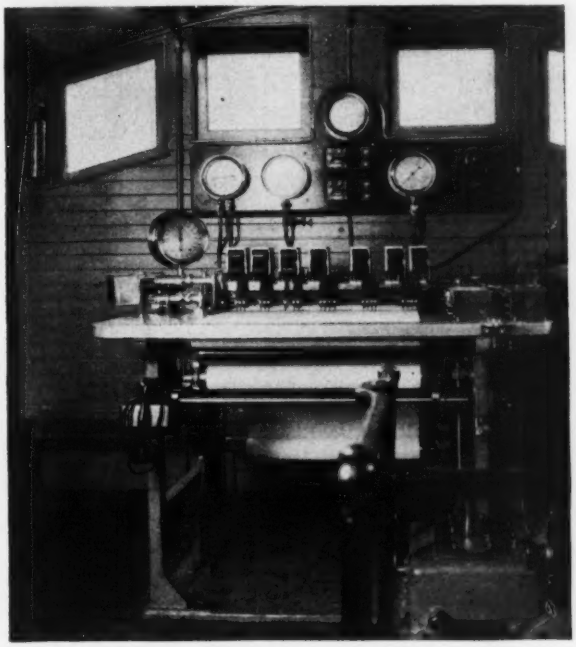


FIG. 2—RECORDING APPARATUS IN CAR

front, the space between them being filled with a mixture of glycerine and alcohol. Each has a maximum travel of about ⅜ in. in either direction from the center line.

Jack screws lock the main yoke lever in central position when the apparatus is not in use. If the lever comes in contact with the jack screw while making tests, an electric bell rings in the cupola, indicating that there is insufficient liquid in the cylinder. Leather diaphragms are used and ½-in. pipes lead from the two ends of the cylinder or weighing head to the chronograph table in the cupola (Fig. 2).

Across this table travels a continuous sheet of paper 24 in. wide, driven from one of the car axles at speeds of 3.3, 13.2 or 52.8 in. per mile of car travel, the intermediate speed being the best for ordinary work. The paper may be driven also by a constant-speed motor when the car is at rest, or when a speed of inches per minute instead of per mile is desired. This motor-driven speed may be 3¾ in., 15 in. or 60 in. per minute. A bar above the table carries supports for 22 recording pens, which trace lines on the traveling chart, as follows: six-second intervals, brake cylinder pressure, two water meters, train-line pressure, front and back air pumps, steam pressure, coal or oil meter, feed-water pumps, back pressure, locomotive indicator, integrator, drawbar pull, buffing pressure, reversing lever, throttle, speed, distance, mileposts or stations, one-minute intervals, six-second intervals. A portion of a record chart is shown in Fig. 3.

Seven datum lines are recorded by aluminum rollers instead of pens, each roller having a rubber stamp which comes in contact with an inking pad and designates the datum line on the chart. This method, which is new, has the advantage of eliminating seven pens and thus simplifying the apparatus and the work of observation. On the table is mounted a small cylinder from which the record of drawbar pull is made. A pipe connects this cylinder with the corresponding cylinder of the weighing head, and movement of the small piston is made against the pressure of a calibrated spring attached to the piston rod. By changing springs the full 3-in. travel of the pen arm is obtained with various drawbar pulls, from 25,000 lb. to 250,000 lb.

A clock with electric contacts makes the one-minute marks on the chart, while the six-second marks on each border are timed from a constant-speed motor which operates the speed recorder. Push buttons on the table

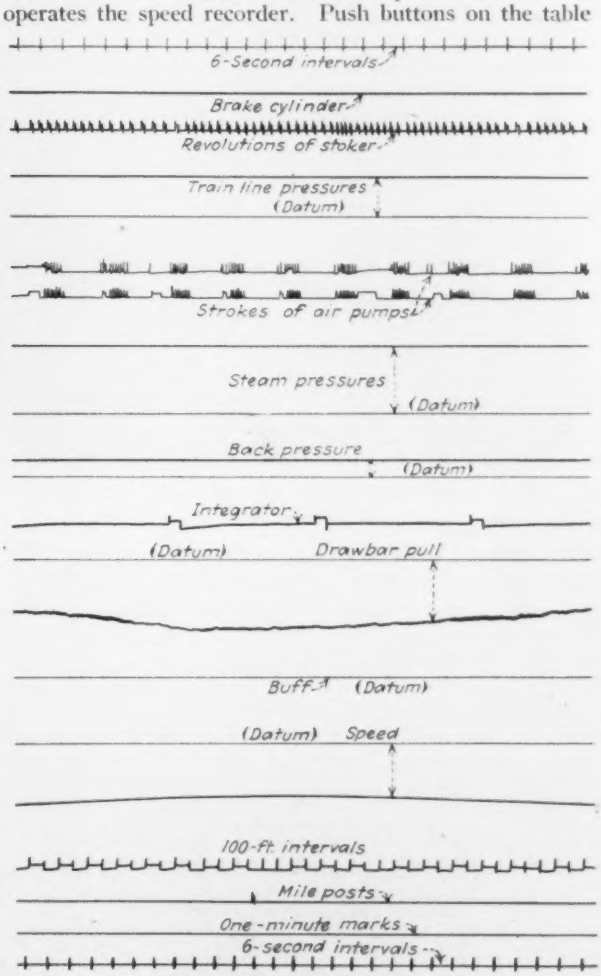


FIG. 3—SAMPLE OF RECORD CHART

and at the cupola windows provide for marking on the chart the positions of mileposts and stations.

This high-capacity dynamometer car, with weighing head and recording apparatus built by the Baldwin Locomotive Works, was designed and built at the railroad shops under the direction of Silas Zwight, general mechanical superintendent of the Northern Pacific Railway.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Arc-Welded Construction in Florida Packing Houses

IN CENTRAL Florida there recently have been erected some fifteen buildings with arc-welded frames composed of a series of arches built up of structural channels as shown in the accompanying illustration. These buildings are largely used as citrus fruit-packing

FIG. 1—FRUIT-PACKING PLANT WITH WELDED CHANNEL ARCHES

houses; the largest one is 117 ft. wide by 202 ft. long and contains 200 tons of structural steel. The entire fabrication of the arches is completed on the ground, after which the arches are raised into position and tied together by welded channel purlins. According to the Lincoln Electric Company, the large structure referred to above was struck by a hurricane before it was completed. The wind blew down the partly completed rear masonry wall, went through the building and wrecked the front masonry wall, but did not damage the steel work.

Concrete Caissons Cast in Place With Quick-Hardening Cement

By Guy N. Berry

Engineer, Ash Grove Lime & Cement Company, Kansas City, Mo.

POURING, sinking and sealing 24 concrete caissons 23 ft. deep in six weeks' time and using but two short form sections was made possible by the use of quick-hardening cement on the foundations for the new South Robinson St. bridge over the North Canadian River at Oklahoma City, Okla. The caissons were 8 ft. 6 in. in outside diameter with a 12-in. wall and were 23 ft. in height.

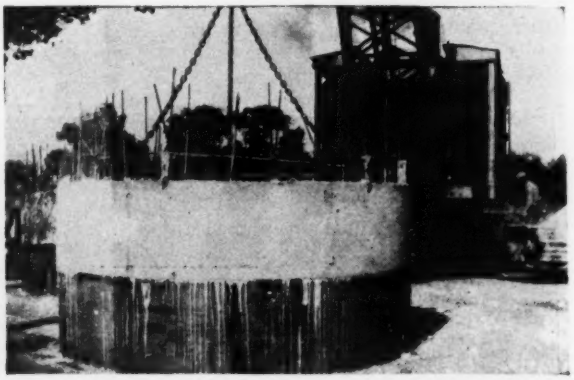


FIG. 1—SHOE SECTION OF CONCRETE CAISSON POURED WITH QUICK-HARDENING CEMENT

Two sets of inside and outside forms 6 ft. high were made of rolled sheet steel and fitted with double-threaded bolts which permitted expansion of the outside and contraction of the inside form for easy removal and placing (Fig. 2). The shoe section was made 5 ft. high and fitted with a 24-in. band of sheet steel to form a cutting edge (Fig. 1). The walls of the caisson were doubly reinforced with ½-in. bars on 12-in. centers both ways. The vertical bars in each section projected 2 ft. above the concrete in order to form a bond with the succeeding section.

Within 24 hours after the shoe sections were cast they were picked up by a crane, set in place and plumbed ready for sinking. Reinforcing and forms for the next section were then placed, and this section was poured from a small portable mixer with a chute leading directly to the forms. The forms were removed within ten to twelve hours and excavation was begun inside the caisson with an orange-peel bucket. The weight of the caisson was sufficient to sink it to rock as the material inside was excavated and the successive sections were poured. Upon reaching rock the caissons were loaded with sand to

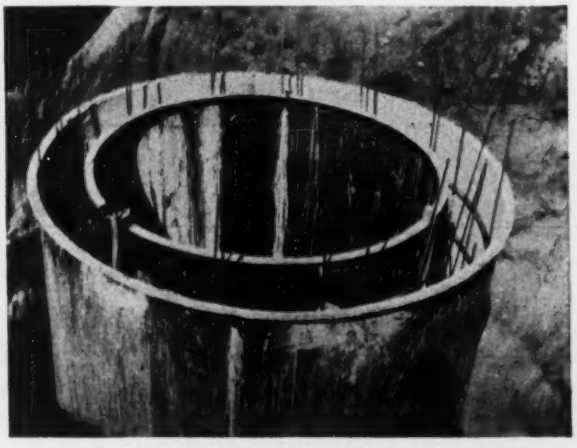


FIG. 2—STEEL SECTIONAL FORMS
Two sets only were used in pouring 24 caissons.

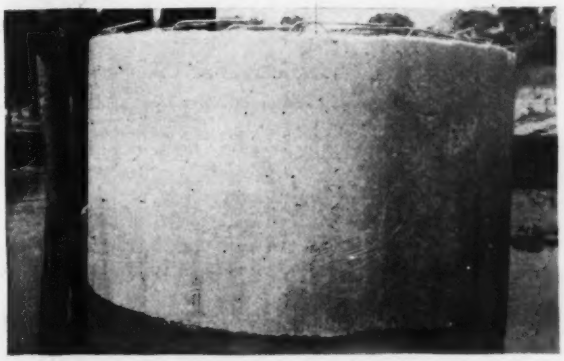


FIG. 3—ONE OF THE COMPLETED CAISSONS

insure a solid seat and were then sealed and filled with concrete.

Maney-Alley & Watson, of Oklahoma City, were the contractors on the structure, with F. E. Watson in direct charge, assisted by J. R. Wygle and Leslie Watson, superintendents.

Overlooking Certain Factors Results in Inaccuracies in Culvert Designs

By George H. McMahon
Hazard, Ky.

IN THE sizing of small drainage structures too little attention has been given to the conditions at the site of structure, including the slope of stream, alignment and roughness of channel and size and shape of structure. As any one of these factors considered separately might affect the result 100 per cent or more, they should receive equal consideration with the size and topography of the drainage area.

All other factors being equal, the discharge will vary with the square root of the slope of a stream. This factor alone may cause a variation of more than 100 per cent in the carrying capacity of a given structure. The effect of vegetation on runoff, while important under ordinary conditions, becomes a negligible factor in districts where maximum discharge occurs when the ground is frozen.

Possibly the simplest method of sizing small drainage structures where no reliable information is available as to maximum discharge at the site of the structure is to obtain values of C for Talbot's formula $X = CA^{\frac{1}{4}}$ from existing structures where similar conditions are encountered. Particular attention should be given to the slope of stream when studying the maximum discharge at existing structures. Values of C for streams on various slopes should be tabulated separately, thus making the value of C for each district studied a variable dependent on the slope of stream. Where backwater conditions are encountered, the stream slope at high water governs.

Values of the friction coefficient n for various channel conditions may vary from 0.03 to 0.06, thus affecting the results by 100 per cent. On sluggish streams the betterment of channel conditions for a short distance below the structure will not materially increase the velocity, and possibly the expenditure for improving the channel will in such cases not be warranted. On streams of considerable slope, however, the improvement of channel conditions for even a short distance below the structure is well warranted and may increase the carrying capacity of the structure enough to repay several times over the cost of doing the work.

Truck Crane on Sidewalk Bridge Assists in Building Demolition

IN WRECKING an old six-story wall-bearing building in Binghamton, N. Y., a truck crane operating on top of a sidewalk bridge was successfully used to lower the floor timbers and the stone in the walls. By the use of a 65-ft. boom, including a wood extension 25 ft. long,

FIG. 1—TRUCK CRANE WITH 65-FT. BOOM OPERATES ON SIDEWALK BRIDGE IN DEMOLISHING A BUILDING

the crane was able to reach to the top story. Stones averaged in weight from ½ to 3 tons. The truck crane handled all of them directly from their position in the wall to trucks in the street.

The crane also erected the sidewalk bridge which extends around two sides of the building and is about 20 ft. high. After two bays were erected from the ground the truck crane pulled itself up a ramp 60 ft. long by pulling on its load line, which had been rigged

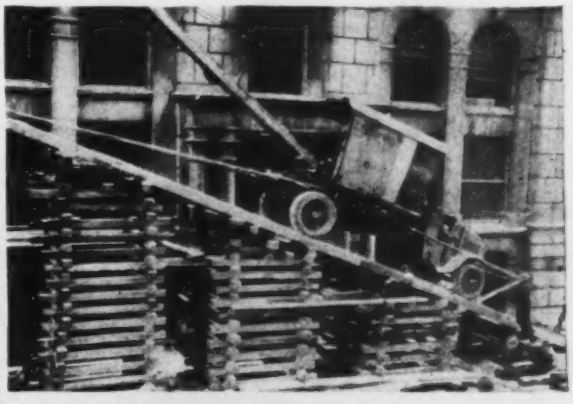


FIG. 2—TRUCK CRANE PULLING ITSELF UP 20 DEG. INCLINE ONTO SIDEWALK BRIDGE

up with double blocks, and by operating both of the niggerheads around which 1¼-in. manila rope had been wound. From its position on top of the completed bays, the truck crane then erected the remainder of the sidewalk bridge.

According to the contractor, A. W. Bowie, Inc., Binghamton, N. Y., the truck crane has advantages in building demolition because it eliminates the necessity of lowering stiff-leg derricks floor by floor; also it gives more flexibility in lowering the stones into trucks, since trucks can be spotted under the crane at any point at which it is working. The total cost of the sidewalk bridge was about $1,200, of which about $500 was expended in strengthening it sufficiently to carry the truck crane.

Test Head Designed to Prevent Leakage During Concrete Pipe Tests

A TEST head that has recently been developed for making hydrostatic tests on lengths of concrete pipe provides an auxiliary seal to prevent leakage during filling. The device consists of a rubber hose that is inflated with water as a preliminary step to seal the joint between the test head and the inside of the pipe. Details of the arrangement are shown in the accompanying sketch.

The test head consists of a steel plate, whose diameter is slightly smaller than that of the pipe being tested, having a rim of two small channel irons that fits inside the pipe. A rubber flange at right angles to the head fits the outside of the rim of channels and forms the actual contact with the inside of the pipe. This flange projects about 4 in. into the pipe beyond the rim and after the pipe is filled with water the pressure on the flange effects a seal around the edge of the test head.

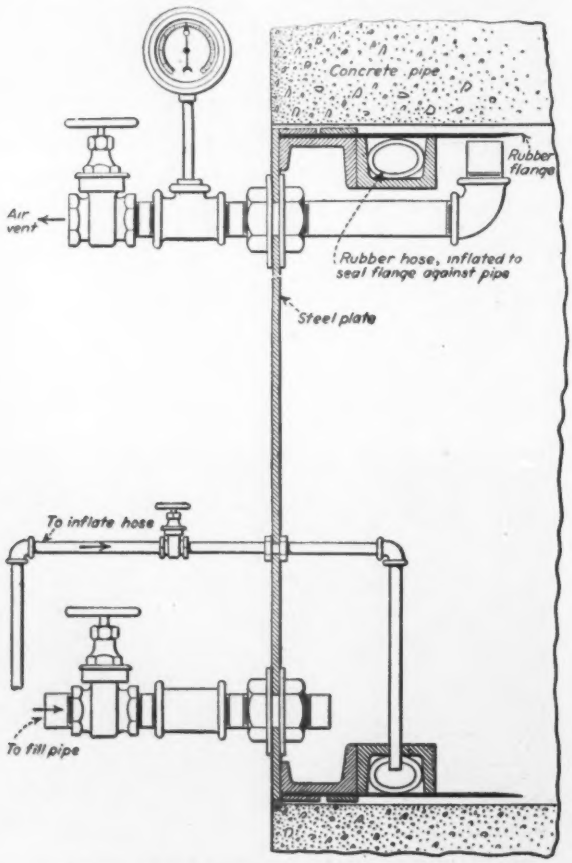
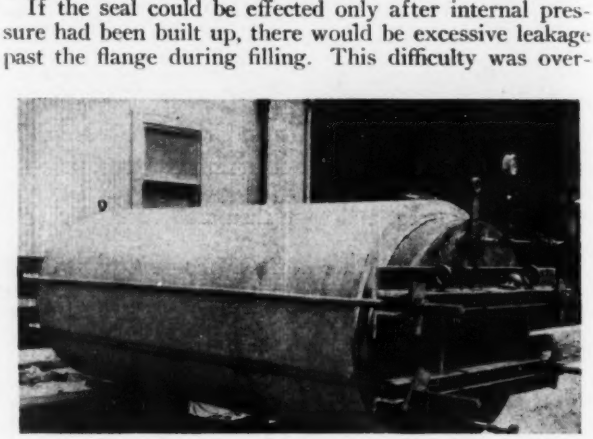


DIAGRAM OF SECTION THROUGH TEST HEAD

If the seal could be effected only after internal pressure had been built up, there would be excessive leakage past the flange during filling. This difficulty was overcome by adding an auxiliary seal to be used when filling. The device consisted of a ring of rubber hose in one of the channel irons, which has its open side toward the pipe wall. A separate water connection leads to this hose and it is inflated before filling the pipe thus sealing the head by pressing the flange rubber against the pipe wall. This eliminates excessive leakage during the main filling and allows a series of tests to be made without hindrance of accumulative spillage.



PIPE SECTION WITH HYDROSTATIC TEST HEAD

The general arrangement for making the tests is shown in the accompanying illustration. The heads are held in position by yokes of angle irons connected by tension rods extending along the outside of the pipe. During filling, air is released at an outlet pipe at the top of the test head. This air vent is closed by a valve when the pipe has been filled with water and the pressure is measured by a gage.

Pressures used for testing depend on the size of pipe and the use for which it was designed; tests on some 30-in. diameter pipe have been made with pressures as high as 120 lb. per sq.in. The device was developed and is used by the American Concrete Pipe Company in its plants on the Pacific Coast.

From Job and Office

Hints That Cut Cost and Time

Auxiliary Welded Beams Permit Use of Old Columns to Carry Added Load

By Robert M. Wilder

Engineer, Seaboard & Southern Construction Company, Jacksonville, Fla.

ONE of the many problems incidental to new construction for the Boca Raton Club at Boca Raton, Fla., was the reinforcing of one section of the existing building to carry an additional story. The old construction consisted of concrete beams supported on 8-in. steel pipe columns and the additional load was to be brought to bear on these beams through interior bearing walls. With the new construction the concrete beams would be

From Job and Office

For Contractor and Engineer

overstressed, but the pipe columns were of sufficient size to take the extra load.

The specifications called for shoring the existing building, removing the steel pipe columns and replacing them by structural H-columns to which auxiliary steel beams were to be riveted directly under the concrete

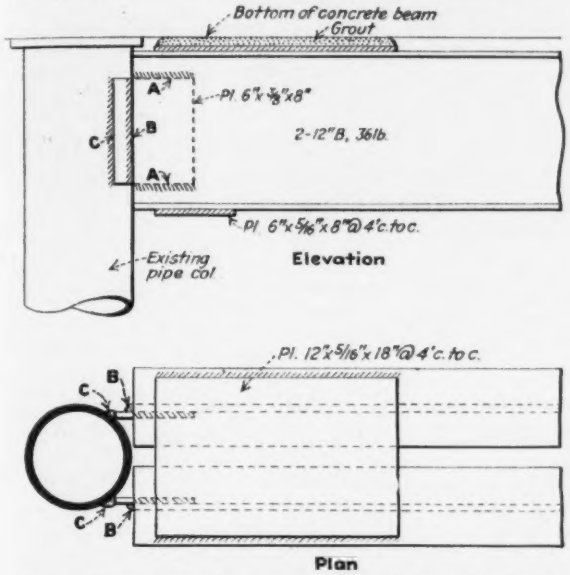


FIG. 1—WELDED CONNECTION BETWEEN AUXILIARY BEAMS AND PIPE COLUMNS

beams. The contractors obtained the permission of the architects to utilize the existing pipe columns and to connect the new steel beams to them by the detail shown in Fig. 1. This detail allowed the use of steel beams without any shop fabrication and, with the exception of the batten plates no overhead welding was required in the operation.

All welding was done with one operator. The beams were first laid in pairs directly beneath the position they were to occupy, with the inside of the webs up, and the connecting plates were clamped in position at each end. Welding of fillet *A* was then done; this beam was turned over by laborers while the operator was working on the succeeding beams. Fillet *B* was then applied and as the operator passed on to the next beams the first beams were raised into position and blocked up rigidly on the scaffolding. Fillet *C* was next applied as well as the necessary welds to the batten plates.

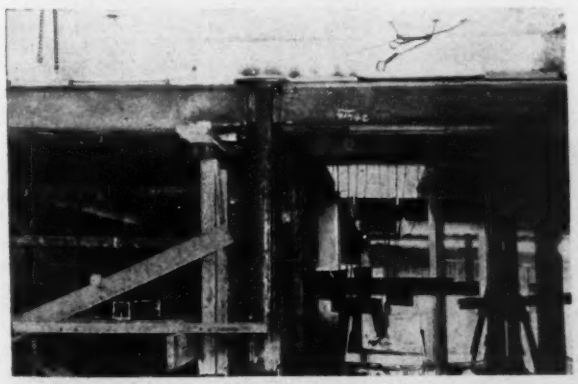


FIG. 2—STEEL BEAMS IN PLACE TO REINFORCE EXISTING CONCRETE BEAMS

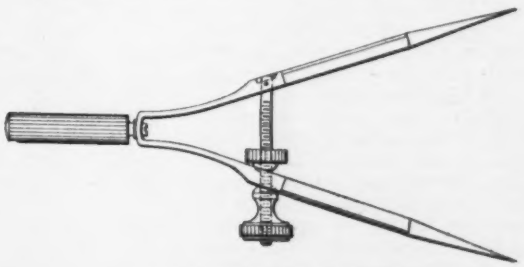
Grout was then placed between the top batten plates and the concrete beams, the scaffolding was removed, and the job was finished without having to resort to expensive shoring and without the necessity of purchasing structural columns. Further saving was effected by the fact that no fabrication of the steel beams was necessary. The finished appearance before field painting is shown in Fig. 2. The horizontal line visible at the end of the beam results from the effect of the heat of welding on the opposite side on the shop paint. This shop paint was removed only from the surfaces that were afterward to be welded.

The general contractor for the entire project was the Seaboard & Southern Construction Company and the method described was worked out by the writer. Russell Redmond was in charge of this portion of the field work. The architects on the building were Schultze & Weaver, of New York.

Locknut Keeps Dividers Open

By Morton Schwam
Philadelphia, Pa.

CRAFTSMEN have all had the experience at some time or other of their dividers or compass collasping slightly in pointing off equal spaces, especially when using the dividers near their outer limits. The accompanying sketch shows a pair of dividers with a



DIVIDERS WITH LOCKNUT

locknut that will prevent any such danger. After the dividers are set to the desired size, the lock on the inside is brought up to the leg of the dividers to hold it in place.

Lighted Streets Guide Aviators

THE fact that two converging streets in Cheney, Wash., form an arrowhead pointing to the airport at Spokane, has been taken advantage of to form a guide for aviators flying at night. The two streets have been equipped with 62 ornamental cast-iron standards carrying brilliant lights, which serve the double purpose of illuminating the thoroughfare and forming an airway marker.

The installation was donated to the town by Mayor C. D. Martin as a memorial to his father and mother, and was designed and manufactured by the Westinghouse Electric & Manufacturing Company.

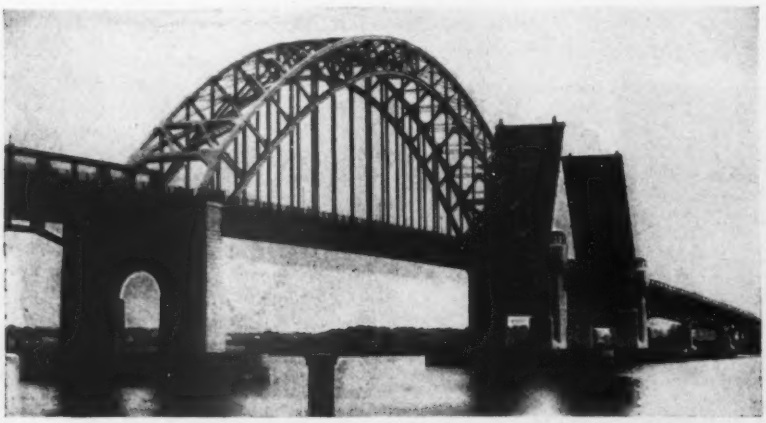
News of the Week

New Bridge Joins Philadelphia With New Jersey

Opening of the Tacony-Palmyra bridge over the Delaware River Aug. 14 provides a second highway connection between the city of Philadelphia and points on the New Jersey side of the river. Like the first connection, the Philadelphia-Camden suspension bridge, the new crossing is a toll structure, although privately owned, whereas the Philadelphia-Camden project is a joint-state enterprise. The new bridge is located some 6 miles up the river from the Camden bridge and joins Tacony, an industrial section of Philadelphia, with Palmyra, N. J. It will permit traffic to and from New Jersey seashore points to bypass the business district of Philadelphia. The cost of the project was approximately $4,000,000 and it was completed and opened within 18½ months after the contractors were instructed to proceed with work on the foundation.

Beginning on the Tacony side, the main bridge consists of a three-span continuous truss of the half-through type, 743 ft. long, a tied bowstring arch 550 ft. long, a bascule span of the rolling-lift type affording a clear opening of 250 ft., and another three-span continuous truss 748 ft. long. The bridge has a roadway 38 ft. wide of concrete except on the bascule span, which has a timber deck paved with asphalt planking. The arch has a clearance of 64 ft., which will give passage for the sand and gravel tows and will accommodate nearly all the vessels now navigating the upper Delaware. The bascule will be available for passing any taller vessel. The bascule span functions as a three-hinged arch when closed and in appearance closely resembles the spans of the continuous trusses.

Modjeski, Masters & Chase, Philadelphia, are the engineers on the project. Tolls will be 5c. for pedestrians, 35c. for motor cars, 50c. for buses and trucks and $1 for double-decked buses and large freight trucks.



TACONY-PALMYRA BRIDGE OVER THE DELAWARE RIVER

50-Year Government Project on Ohio River Near Completion

The opening, within a week or so, of Dam No. 53 at Grand Chain, Ill., 18 miles above the mouth of the Ohio River, will mark the completion of the last of the federal government projects which provide a minimum 9-ft. channel depth from Pittsburgh to Cairo. This project has been under way for 50 years and has cost about $125,000,000.

Dam No. 53, the last of a series of 50 placed at intervals along the 980-mile length of the Ohio River, cost $5,000,000 to build. It has a lock chamber 110 ft. wide and an estimated lift of 9 ft.

Succession of Accidents Causes Water Famine in Albany

A large part of Albany, N. Y., was without water supply for 24 hours during the first week in August as a result of a succession of accidents.

A break in one of the city mains shut off the supply from a large section of the city. This main had been in service only a month and an attempt to bring into service as an auxiliary an old main that had been replaced by the new resulted in a break in a gate valve, and this stopped the flow again. Later in the day another auxiliary pipe line, from Van Rensselaer Lake, was called upon, but this also broke. Then a transformer in the pumping station failed, and experts had to be called in from the power and light company.

Repairs were made during the night and the forenoon hours of the following day, and there was a normal flow by evening.

Rio Grande Flood Damages Property in New Mexico

By J. L. Burkholder

Chief Engineer
Middle Rio Grande Conservancy District

A flood occurring in the lower portion of the middle Rio Grande Valley in New Mexico, Aug. 13-14, resulting from the combined high discharges from the Rio Grande, the Rio Puerco and the Rio Salado, caused damage estimated at $600,000. The damaged area extends from the confluence of the Rio Puerco with the Rio Grande on the north to San Marcial on the south, a distance of approximately 60 miles, including about 10,000 acres of farmland, numerous small villages occupied by Spanish-American farmers, and the town of San Marcial, population 1,500, which is a subdivision point on the El Paso-Albuquerque branch of the Santa Fe Railway. The major portion of this area, except San Marcial, is included in the Middle Grande Conservancy District, which has developed plans for flood control, irrigation and drainage

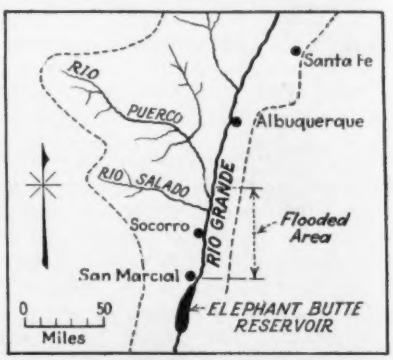


FIG. 1—AREA AFFECTED BY NEW MEXICO FLOOD

of the area, and expects to begin construction work in the near future.

The drainage area of the Rio Grande above the mouth of the Rio Puerco is 18,725 square miles, the drainage area of the Rio Puerco is 5,170 square miles and the drainage area of the Rio Salado is 1,148 square miles. From a preliminary examination of high-water marks and stream sections, it appears probable that the discharge of the Rio Puerco at its mouth was about 31,000 sec.-ft., that of the Rio Salado at its mouth was probably 27,000 sec.-ft. and at the same time the Rio Grande was discharging perhaps 5,000 sec.-ft. The flood spread over a broad area in the main valley of the Rio Grande, with a discharge at San Marcial estimated at 25,000 sec.-ft.

Greater discharges at San Marcial have been recorded on three occasions

in the past, the last of these in 1920. A maximum of 33,000 sec.-ft. was noted in 1904. These past floods caused very little damage to cities and towns, and the flooding was largely confined to marginal farming lands. The flood of Aug. 13 is more severe, due in part at least to the silting of the riverbed in the vicinity of San Marcial and to the deposit of a silt plug at the head of the Elephant Butte Reservoir, which is immediately below the town of San Marcial. The accumulation of silt has raised the bed of the Rio Grande to an elevation several feet above the area occupied by the town of San Marcial. The river is held back by small dikes paralleling the railroad track. These dikes were not breached during the recent flood, but inundation of the town was caused by backwater coming around the end of the levee and by direct seepage from the river. Thus the town was spared from the force of rushing waters, but was covered with from 3 to 5 ft. of still water. This flooding caused more than the ordinary amount of damage because many of the buildings were constructed of adobe, which collapsed due to the saturation of the walls.

Photo courtesy New Mexico Tribune

Fig. 2—AIRPLANE VIEW OF FLOODED SAN MARCIAL, N. M. the high-water mark is shown by the solid line.

N.E.W.W.A. Electing Officers

Members of the New England Water Works Association are electing by letter ballot new officers for the coming year. The names of the official nominees are: for president, Robert Spurr Weston, of Webster & Sampson, consulting engineers, Boston, Mass.; for vice-president, George C. Brehm, city engineer and director of public works, Waltham, Mass.; for treasurer, Albert L. Sawyer, water registrar, Haverhill, Mass.; for directors, E. Sherman Chase, of Metcalf & Eddy, consulting engineers, Boston, and R. A. Cairns, city engineer, Waterbury, Conn.

Two Western Power Systems Interconnecting Lines

Work is now under way on the construction of a 44-kv. transmission line, about 70 miles long, to interconnect the systems of the Utah Power & Light Company and the Telluride Power Company. The new line will run from the present Santaquin (Utah) station of the Utah company to connect with the Telluride company's lines at Gunnison, Utah, via Nephi and the Salt Creek canyon. Each company will build one-half of the line, and the work is expected to be finished about Nov. 1, 1929.

New Highway Toll Bridge in Colorado

A one-span suspension highway toll bridge is being constructed across the Royal Gorge, near Canon City, Colo., at the remarkable height of 1,050 ft. above the bed of the Arkansas River. The bridge will be 18 ft. wide and 1,250 ft. long, exclusive of the approaches. There will be four cable towers, two on either side and at heights varying from 125 to 190 ft. It is estimated that more than 300 tons of cable will be used.

I.C.C. Rules Against Off-Track Freight Deliveries in N. Y.

The U. S. Interstate Commerce Commission last week ruled against the operation by railroads in New York City of "constructive station" service and of trucking in lieu of lighterage, and ordered its discontinuance where practiced, on the ground that it was "undue preference and unjust discrimination." The effect of the decision is to suspend all off-track deliveries by railroads operating on Manhattan Island.

The commission's order pointed out that the Merchants' Association of New York advocated the establishment of "true" store-door delivery, under arrangements to be fixed, whereby a portion of the cartage charge would be borne by the shippers and the deliveries confined to "reasonable limits." The association has submitted a definite plan for store-door delivery in New York which will be considered later.

Florida Appoints Flood-Control and Drainage Boards

In accordance with legislation passed May 29 by the Florida Legislature providing for the creation of two commissions to supervise flood-control projects and drainage work in the Lake Okeechobee district (*Engineering News-Record*, June, 6, 1929, p. 919) Governor Carlton has announced the personnel of the two boards. Members of the Everglades Drainage Board are: Marcus A. Milam, Miami, merchant and property owner; Ralph A. Horton, Fort Lauderdale, business man and president of the board of supervisors of the Broward drainage district; Dr. W. H. Lair, Pahokee, banker, physician and former county commissioner and drainage supervisor; C. E. Simmons, Okeechobee, farmer; and D. Graham Copeland, Everglades, civil engineer and general manager of the Barron G. Collier properties in Florida.

The personnel of the Flood-Control Board consists of: Glenn H. Curtiss, Hialeah, airplane manufacturer; Russell H. Snow, Fort Lauderdale, merchant; Howard Selby, West Palm Beach, banker; F. Deane Duff, Clewiston, civil engineer and general manager of Southern Sugar Company; and William Griffis, Okeechobee, owner and publisher of the Okeechobee *News* and secretary and a director of the Florida Flood-Control Association.

Court Rules Against Resubmission of Pittsburgh Charter

In an opinion handed down by the Common Pleas Court it is declared that the county commissioners of Allegheny County, Pa., "have no duty or discretion in the placing of the question of a charter for the Consolidated City of Pittsburgh upon the ballot, and they are directed to omit the same from the ballot of the next general election." According to the court further legislative action is necessary before the charter plan may be submitted again to an election.

The proposed charter, which was abstracted at length in *Engineering News-Record*, March 28, 1929, p. 496, failed to receive the required number of affirmative votes when submitted to the voters on June 25, 1929.

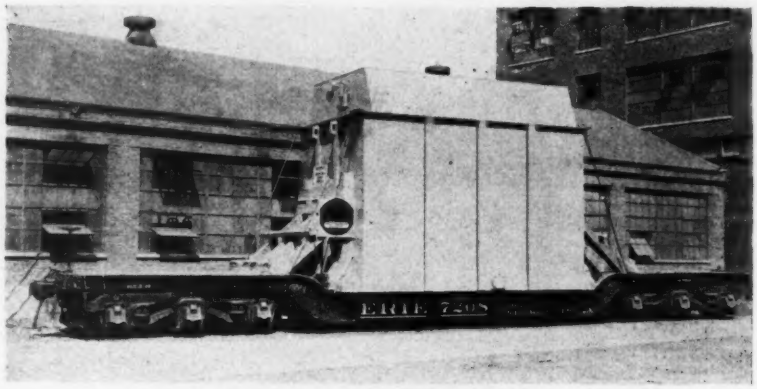
Requests Power License in North Carolina

Application has been made to the Federal Power Commission for a license covering a 33,000-hp. development on the Roanoke River in Halifax and Northampton counties, North Carolina, by the Virginia-Carolina Power Company, of Roanoke Rapids. It is proposed to construct a dam above Roanoke Rapids creating a reservoir 7 miles long, generating power for sale to the Virginia Electric & Power Company. An ultimate installation of 55,500 hp. is planned.

Prequalification Rules Adopted for Baltimore Bidders

The Public Improvement Commission, Baltimore, Md., a municipal department, has adopted a new rule to apply to contractors bidding on new schools to be erected out of a $10,000,000 loan which is available. Bidders on specifications must present evidence of their ability, financial responsibility and practical experience. They must submit with their bids one or more examples of their work to show the similarity, comparative size and contract cost of the buildings, their names, locations and dates of completion. At the time the bids are made those submitting them must be engaged in the contracting and building business and must have been directly responsible for and actually engaged in or directing the construction of the buildings submitted as examples.

When a corporation makes a bid, one of its active officers must possess the practical experience of a builder or engineer who has acted in that capacity on the example submitted.



A CARLOAD OF 135 TONS

Special shipping arrangements, including the strengthening of bridges and the lowering of railroad tracks 18 in. at one point to increase clearance, were necessary to transport four of the largest electric power transformers ever built from the Sharon, Pa., plant of the Westinghouse Electric & Manufacturing Company to Roseland, N. J. Each of the transformers is 35 ft. high, weighs approximately 300 tons, and requires 32,000 gal. of insulating oil. Dismantled for shipment, the largest individual units weigh 270,000 lb., these being loaded, as shown above, on a special type of depressed car.

American Association Abandons Convention in Mexico

The scheduled annual meeting of the American Association of Engineers in Mexico City Aug. 26-28 has been abandoned and will be replaced by a convention in Chicago early in October to effect a reorganization in accordance with changes in the constitution recently voted upon. Delegates to the Pan American Congress of Engineers in Mexico City will be sent to represent the association officially, but only one or two informal meetings will be held, the program being made up from engineers in the Southwest who can speak Spanish. About 125 members have signified their intention of attending the Mexican meeting.

Plan Power Developments in the Northwest

The Federal Power Commission has granted a preliminary permit to the Inland Power & Light Company, Portland, Ore., to develop 160,000 kw. on the Lewis River in southwestern Washington. Actual construction will not begin until the issuance of the license, but work on the transmission line from Vancouver, Wash., to the site is to be started at once so that power for construction will be available when needed. Foundation tests for the dam have been completed.

Development of the project is planned in four units of 40,000 kw. each. A single dam, 190 ft. high above normal water level, will create a lake about 12 miles long, impounding approximately 220,000 acre-ft. A single power house, designed to be expanded as units are added, will be located immediately below the dam. The dam and first unit are estimated to cost $8,250,000, with the total ultimate cost of the four units without transmission lines estimated at $11,500,000.

A preliminary permit has also been granted by the Federal Power Commission to the Washington Electric Company, of Seattle, a Puget Sound Power & Light Company subsidiary, for its Rock Island power project on the Columbia River, near Wenatchee, Wash. The plans include the erection of a low dam at Rock Island for the generation of 60,000 kw. in the initial unit and transmission of this power to Seattle over two new lines crossing the Cascade Mountains. Ultimate development entails the production of 180,000 kw., to be distributed over the company's system in Seattle and elsewhere in Washington.

Application for a preliminary permit has been made to the commission by the city of Vancouver, Wash., covering a proposed development on the north fork of the Lewis River ½ mile above Swift Creek. An installation of 80,000 hp. is proposed, of which 32,000 would be primary power.

First International Lighthouse Conference Held in London

The first international lighthouse conference that has ever been held met in London in July on the invitation of Trinity House, the English lighthouse authority. Trinity House is an organization with a long record of high achievement in the lighthouse work of the world. It holds a charter granted in 1514, and it has carried out some of the most important lighthouse engineering works, such as the building of the lighthouses on Eddystone Rock and Bishop Rock.

The conference included representatives of the lighthouse authorities of 24 countries and also of a number of local lighthouse organizations and interested industries. It was entirely informal, its purpose being the exchange of information and the discussion of problems affecting lighthouse systems; it did not undertake to pass final judgment on any matter. Sessions were held from July 8 to July 12, and during the following week inspection trips were made to various works. The principal topics of discussion were lighthouse illuminants, unattended lighting systems, aerial lights, floating aids to navigation, including lightships and buoys, lighthouse structures, fog signals, radio beacons and other related matters. The proceedings will be published by Trinity House.

Representatives of the United States were: George R. Putnam, commissioner of lighthouses, Washington; J. T. Yates, superintendent of the Third Lighthouse District, New York, and H. W. Rhodes, superintendent of the Eighteenth Lighthouse District, San Francisco, all of the Department of Commerce.

Incinerator Construction in San Francisco Delayed

Despite the adoption June 10 of three measures providing for the construction of a new garbage incinerator in San Francisco, the Board of Supervisors of that city has decisively defeated a motion to place the question of a $1,000,000 bond issue for the new incinerator before the voters at the November election. This makes the question as to the time of any definite action on the new incinerator very uncertain. As noted in *Engineering News-Record*, Aug. 8, 1929, p. 233, the city has been threatened for months by an injunction to close down the present municipally owned and operated incineration plant as a public nuis-

ance. Formal judgment has been withheld in the hope that remedial measures would be adopted.

Results of a personal study of plants in operation in Eastern cities were presented to the Board of Supervisors Aug. 12 by M. M. O'Shaughnessy, city engineer. The proposal to place the bond issue on the ballot was defeated the same day.

Brief News

GAS SUPPLY LINES 480 miles in length are planned to connect the Ruhr district with cities in southern Germany.

BIDS HAVE BEEN REQUESTED by the Burma Railways for a ¾-mile bridge over the Irawaddy River, consisting of nine 350-ft. spans and one 250-ft. span, with piers and abutments. It is estimated that the project will cost £1,000,000.

CONSTRUCTION of the new depot in Atlanta, Ga., for the Nashville, Chattanooga & St. Louis Railroad will begin soon, following the award of the contract to the Southern Ferro Concrete Company for $575,000. The date set for the completion of the structure is March 31, 1930.

CONSTRUCTION OF FOUNDATIONS in the Borough of Queens for the new roadway on the upper deck of the Queensboro bridge, New York City, has been commenced by the Bersin-Romm Engineering Corporation, which obtained the contract with a bid of $548,000. The new roadway is designed to accommodate three lanes of traffic and will extend 10,300 ft.

UTILIZATION OF HYDRO-ELECTRIC POWER from the Saale River in Thuringia, Germany, is now in progress by means of cutoff tunnels at the oxbows of the river. Several of these have already been completed. The Saale River in this country has a total length of approximately 207 miles between two points approximately 52 miles apart.

A CONTRACT for the largest gravel plant outside of the United States has been closed by the Smith Engineering Works, Milwaukee, Wis., with Russian interests. The contract calls for ten carloads of machinery at a cost of nearly $50,000. The gravel plant, which will furnish material for the construction of an 80,000-kw. hydro-electric plant near Leningrad, will be placed in operation next spring.

WORK on the second and final steel tower of the vehicular bridge over the Hudson River from Highland to Poughkeepsie is practically completed and spinning the cables has been started. The bridge is to be 4,072 ft. long, with a main span of 1,500 ft. between piers, the approach spans being 750 ft. each. A roadway width of 30 ft., with 5-ft. sidewalks, is being provided.

WASHINGTON NOTES

BY PAUL WOOTON
Washington Correspondent

Six Being Considered for Chief of Engineers—Fundamentals of Traffic to Be Subject of Survey

NO CONSIDERATION will be given the views eligibles may entertain toward the Mississippi flood-control work or any other particular project before the Corps of Engineers in selecting the new Chief of Engineers, the Secretary of War declares. The Jadwin flood-control plan is now the law, Secretary Good said, and it will be the duty of the new chief to carry it out as such. As the failure to name the new Chief of Engineers has not imposed an undue burden on the work of the War Department, Secretary Good does not believe that there is any necessity for immediate action in filling the vacancy caused by General Jadwin's retirement. Because it is believed that the problems now before the army engineers are greater than those presented in the construction of the Panama Canal, unusual care must be exercised in choosing the new chief, he stated.

Just what qualifications must be possessed by the officer who is to head the engineering activities of the War Department has not been made clear, but the Secretary is responsible for the statement that he must be an outstanding engineer and must be able to meet the public. Asked if the qualification of meeting the public means that the new chief will be expected to preserve friendly relations with the civil engineers as a class, he said he meant no reflection on the ability of past chiefs to get along with outside interests. It is simply that the growing responsibilities that are crowding upon the office of the Chief of Engineers makes it necessary for an officer to be selected who can properly express the policies of the government to the people, he said.

The opinion exists in some quarters that there is no great uncertainty about General Deakyne's advancement to the post of Chief of Engineers but that the real contest is over the office of assistant chief. This is not the case, Secretary Good states. The office of assistant chief is receiving scant consideration, he pointed out, as it is presumed that General Deakyne, who is at present assistant chief, will retain this position in the event he is not promoted. If General Deakyne is promoted, the Secretary added, there will be plenty of time to decide who shall be assistant chief. The selection has narrowed to six names, he said.

Further Development of Colorado River

Passage of the Swing-Johnson bill has diminished in no sense certain of the controversial features pertaining to the development of the Colorado River; the demand that no rights be granted on that river or its tributaries is as strong as ever. On the other hand, those whose projects have been held in abeyance for years are anxious to proceed with them, as is provided in the water-power act. This is particularly true with regard to the projects on the Gila River. A number of constructed projects in the Colorado River watershed are anxious to have legalized their occupancy of public lands. As Congress has specifically and definitely lifted the ban which it laid upon projects in the watershed while the bill was pending, it is assumed that the Federal Power Commission would feel that it would be taking a good deal upon itself to withhold action further.

Distribution Census to Cover Contracting

Inclusion of the operations of construction contractors in the first national census of distribution has been decided upon by the executive committee on census planning appointed by Secretary of Commerce Lamont. Discussion developed that without including contractors in the canvass it would be impossible to obtain comprehensive information on the distribution and use of various types of construction materials at a time when substitution and the introduction of new materials are of peculiar significance not only to the construction industry but to the industries supplying the materials issued.

Oppose Great Falls Project

That the parks "should fit into the scheme of the nation and not the nation into the scheme of the parks" is one of the points made by General Jadwin in submitting minority views on the report of the National Capital Park and Planning Commission. General Jadwin, during his term as Chief of Engineers, served as chairman of this commission. The other members took the position that it would be "inadvisable to decide now upon the destruction for all time of the scenic and recreational and inspirational assets of such large prospective importance as those included in the valley of the Potomac at the doors of the national capital."

This report will be submitted to Congress along with that of General Jadwin in his capacity as Chief of Engineers, which favors the development of power on the Potomac at Great Falls. General Jadwin concurs in the report of the district engineer, Major Brehon B. Somervel, who estimates the cost of power produced at Great Falls under the plan submitted by the Potomac River Corporation at approximately $1,000,000 per annum cheaper than the equivalent steam power. The various potential values that would result from a national development of resources of the Potomac aggregate $48,000,000 as follows: (*a*) savings on production of hydro power instead of steam power, capitalized on a 6 per cent basis at $15,000,000; (*b*) saving by elimination of two bridges, $3,000,000; (*c*) savings in the form of income from taxes at the rate of 2 per cent capitalized at $14,000,000; (*d*) savings which the power structures would produce if navigation should be

extended up the Potomac River, amounting to $14,000,000; (*e*) savings on preliminary treatment of the Washington water supply and estimated value of flood protection, $2,000,000.

Mississippi Towboats

All bids for the construction of diesel-driven compressed-air towboats for service on the upper Mississippi were rejected at the meeting of the board of the Inland Waterways Corporation Aug. 1, and it was decided to invite new bids based on steam propulsion. It is understood that excessive cost is the reason why the bids for the diesel-compressed-air boats were thrown out.

Consideration is being given also to the advisability of buying new and more powerful towboats for the New Orleans-St. Louis service. The problem confronting the power engineers, it was brought out at the board meeting, is to develop a propeller that can be installed on the shallow draft vessels that navigate the inland waterways. It has been the experience of the Inland Waterways Corporation not only that the propeller type boats are more efficient in their mechanical performance than the stern wheel type but that they also can be maneuvered more easily.

To Investigate Congestion

A courageous sifting of the basic causes of traffic congestion is promised during the initial meeting next month of a special group of the committee on street and highway safety, headed by E. J. Mehren. While no definite program has been announced at this time, it is known that attention will be given to phases of the metropolitan traffic problem which heretofore have received scant consideration because of their magnitude. This is in reference to such fundamental remedies as segregation of traffic on different levels and night deliveries of commercial products.

It is also understood that the advisability of providing municipal parking facilities will be taken up. In this connection it has frequently been pointed out that there are large areas of unused space in many cities that can be converted at a comparatively small cost into parking lots. This would be much more economical, it is contended, than using increased street widths for more parking.

Another phase of the traffic problem that it is expected will be studied is the relative rights of the various types of vehicles to the use of the streets. By means of a comprehensive survey it can be demonstrated which vehicles perform the greater public service. When accurate information is available on this matter, it is believed that many of the difficult points of the traffic problem will tend to solve themselves. Merchants, it is pointed out, will voluntarily do away with some of the spaces set aside for shipping purposes, if facts can be presented to them showing how such use of the streets impedes the flow of traffic and forces business to other sections.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN WELDING SOCIETY, New York; fall meeting, Cleveland, Ohio, Sept. 9-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; annual convention, Portland, Me., Sept. 16-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; fall meeting, Boston, Mass., Oct. 9-11.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; annual meeting, New Orleans, La., Oct. 15-17.

ASPHALT PAVING CONFERENCE, New York City; annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

* * *

THE WISCONSIN SECTION of the American Water Works Association will hold its eighth annual convention in Kenosha, Sept. 17-18.

THE NEW YORK STATE ASSOCIATION OF CITY AND VILLAGE ENGINEERS will meet in Rochester, N. Y., the last week in September.

THE AMERICAN ASSOCIATION OF PORT AUTHORITIES will hold its annual convention in Quebec, Canada, Sept. 23-26. T. S. McChesney, 200 New Orleans Court Building, New Orleans, La., is secretary.

Personal Notes

O. H. AMMANN and GUSTAV LINDENTHAL have been added to the staff of the Chicago Museum of Industry and Science. Mr. Ammann is chief engineer of bridges for the Port of New York Authority, and Mr. Lindenthal is well known in connection with his work on the Hell Gate and 57th St. bridges in New York, among others. They will aid in the development of an exhibition of bridges from earliest times to the present.

IRA D. S. KELLY has resigned from the Illinois division of highways and is now with the Kansas State Highway Commission, in the office of the engineer of design.

Lieut. Col. THOMAS M. ROBINS has been relieved from duty as chief of the rivers and harbors section in the office of the Chief of Engineers at Washington and ordered to Portland, Ore., effective Nov. 13.

GEORGE L. FREEMAN, formerly chief engineer of the Foundation Company, has joined the organization of Moran & Proctor, consulting engineers, of New York.

F. R. GEORGE, since 1920 engineer of operations for the Pacific Gas & Electric Company, with headquarters in San Francisco, has been appointed engineer of electrical operation in charge of operation and maintenance of the company's electric, water and steam properties, and of general line construction, effective Aug. 1.

EDWIN W. KRAMER, hydro-electric engineer of the California district of the U. S. Forest Service, has been made district engineer, succeeding Frank E. Bonner, whose appointment as secretary of the Federal Power Commission at Washington, D. C., was recently announced.

C. M. ADAMS has recently returned to the United States after 2½ years' absence in the Dominican Republic, where he was supervising engineer in charge of the construction of the $2,500,000 water-works and sewer system in Santo Domingo. Mr. Adams will remain a few months in the East and then will return to his home in Bellingham, Wash., to open an office as consultant.

Major GLENN E. EDGERTON, who has been serving as chief engineer of the Federal Power Commission, has been relieved from that detail and has gone to the United States Military Academy to take charge of the department of civil and military engineering.

FRANK H. COTHRAN has been appointed vice-president and general manager of the Beauharnois Construction Company, a subsidiary of the Beauharnois Power Company, which has commenced work on the building of a power canal on the St. Lawrence. Mr. Cothran is a hydro-electric engineer and has been vice-president and general manager of the Duke-Price Power Company and the Quebec Development Company and, more recently, chief engineer of the Piedmont & Northern Railway.

Obituary

FRED E. SMITH, San Joaquin (Calif.) county engineer, died on Aug. 8 after a long illness. He had been connected with the county engineering department for thirteen years.

JOHN HAMER, superintendent of bridges and building on the Mohawk division of the New York Central Railroad, died suddenly in Albany, N. Y., on Aug. 10. He was 62 years old.

JAMES J. AHEARN, vice-president of the Uvalde Asphalt Paving Company, New York City, died on Aug. 12. He was 52 years old and had been connected with the Uvalde company for fifteeen years.

PAUL JULIAN, of Indianapolis, a retired engineer, died recently in a hospital at Lafayette, Ind., where he had been confined for the last four years. He was 62 years old. In 1890 he was elected surveyor of Marion County and served for five terms. For several years he maintained an office in Indianapolis and designed several large bridges in and about the city.

Construction Equipment and Materials

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of July, 1929, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1929 to date as of Aug. 3:

	Sq.Yd. Awarded During July, 1929	Sq.Yd. Awarded From Jan. 1, 1929 to Aug. 3, 1929
Roads	11,344,047	62,190,761
Streets	6,216,162	27,215,672
Alleys	462,221	2,098,079
Totals	18,022,430	91,504,512

Census Officials Ask Advice of Manufacturers

With a view to making the forthcoming census of manufactures as responsive as possible to the need of industry for accurate information concerning its own activities, the special advisory committee designated by Secretary Lamont has requested manufacturing organizations, trade associations and individual manufacturers for advice and suggestions as to the form of the schedule to be used in the enumeration. The subjects covered by the schedule used in the 1927 census are: description of establishment; character of industry; time in operation; persons engaged; salaries, wages and materials; products; power; coal consumed. The committee has invited suggestions concerning the form of questions under all these subjects except production, which will be taken up directly by the Bureau of the Census with the industrial associations.

In view of the fact that it will be necessary to begin the printing of the general schedule in September, comments on the general schedule should be sent to the secretary of the committee, Thomas W, Howard, 1615 H St., N. W., Washington, D. C., as promptly as possible in order that they may be given consideration by the committee preparatory to recommending the revision of the schedule.

New Developments

Auxiliary Rail Used on Road Form

In an effort to eliminate the tendency of the usual concrete road form to tip under the heavy load of the modern finishing machine, the Lakewood Engineering Company, Cleveland, Ohio, has designed a new type of form known as the Duo-Rail, which centers the load of the finished machine over the base of the form by means of an auxiliary

ASSEMBLING AUXILIARY RAIL TO CARRY FINISHING MACHINE

rail held in place by dowel pins fitting into holes in the stake pockets. The base of the form is 8 in. wide, giving ample bearing area. The auxiliary rail is used for the finishing machine only, being added to the form as needed. Approximately 100 ft. of the auxiliary rail is all that is used on each side of the road. Foot bridges and other lighter equipment are carried, as usual, on the form proper, which also acts as a templet for the screed member of the finishing machine.

Snow Fence Designed for Easy Handling and Storage

Many advantages are claimed for a new type of snow fence known as Sno-bar, manufactured by the George L. Barrus Company, Lithia, Mass. This consists of a folding post made of rust-resisting metal which is erected in the shape of an inverted V, one leg of which is slotted to take 1x6-in. boards, which may be obtained locally. These are slipped into the slots in the post and automatically locked by their own weight. Occasional timber braces against the standards prevent deflection in an endwise direction.

SNOW FENCE MADE UP OF STEEL STANDARDS AND BOARDS

The standards are made in three sizes, 4, 5 and 6 ft., for varying climatic conditions. They are anchored to the ground by stakes driven through slots in the lower sections of the legs. As the units do not weigh more than 20 lb., easy portability is assured, and the collapsible feature makes storage a simple problem. It is stated by the manufacturers that by using 14-ft. boards 100 ft. of fence can be erected with approximately eight standards and 309 board-feet of lumber.

New Metal Retains Strength at High Temperatures

Development of a new metal, known as Konel, which is credited with being much stronger than other metals at high temperatures and which can be used extensively in the moving parts of internal combustion engines and other extremely hot places, has been announced by officials of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The announcement followed the granting of foreign patent rights. Originally developed by the Westinghouse Research Laboratory as a substitute for platinum in the manufacture of filaments for radio tubes, the new metal was discovered to be harder to forge than steel and to be very tough at high temperatures, when most metals lose their strength. Engineers predict many uses for Konel, which was created by E. F. Lowry, a graduate of Ohio State University.

New Publications

Road-Patching Material — TEXAS COMPANY, New York City, has issued a new edition of its booklet on the repair of roads and streets by the cold patch method. The 24-p. booklet gives detailed directions for obtaining satisfactory results under all conditions.

First Aid Supplies—MINE SAFETY APPLIANCES COMPANY, Pittsburgh, Pa., has issued a catalog of first-aid supplies and kits for emergency use.

Mixer Trucks—TRANSIT MIXERS, INC., San Francisco, Calif., in a recent 16-p. booklet describes the Transit system of mixing concrete while in transit on motor trucks. Transit mixers are built to fit various standard makes of trucks in capacities varying from 2 to 5 cu.yd.

Electrical Equipment — GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of recent bulletins, each describing a single product of the company. Among these are: elevator motors, immersion heaters, a gas

engine-driven arc-welding generator, a travel carriage for automatic arc welders and a number of types of air compressors.

Centrifugal Air Compressors—ALLEN AIR APPLIANCE COMPANY, INC., New York City, has issued a bulletin outlining the advantages of the centrifugal type of air compressor and describing the products of the company.

Excavator—GEORGE HAISS MANUFACTURING COMPANY, INC., New York City, in bulletin 629 describes the Haiss bucket-type excavator, showing by illustration and text the performance of the machine on various types of excavating jobs.

Truck Cranes—UNIVERSAL CRANE COMPANY, Lorain, Ohio, devotes bulletin 48 to the uses of its truckcranes for rental purposes. Many possible jobs for truckcranes are outlined and tabulations given showing typical costs of operation.

Business Notes

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has purchased a 22-acre site in Newark, N. J., which will be used for a new warehouse and service station to serve the entire industrial area of northern New Jersey.

ALPHA PORTLAND CEMENT COMPANY, Easton, Pa., has appointed J. G. Bragg, formerly service engineer, Eastern sales manager for the company.

LONE STAR CEMENT COMPANY INDIANA, INC., has elected George E. Pierson, formerly manager and sales manager, vice-president of the company. Mr. Pierson will relinquish his duties as sales manager, but will continue as manager.

BRITISH COLUMBIA WOOD PRESERVING COMPANY, LTD., New Westminster, B. C., has been formed as a subsidiary of the Alberta Wood Preserving Company, Calgary, Alta., and will erect a plant to cost about $500,000 for the production of piling, culvert timbers, bridge timbers and other treated lumber.

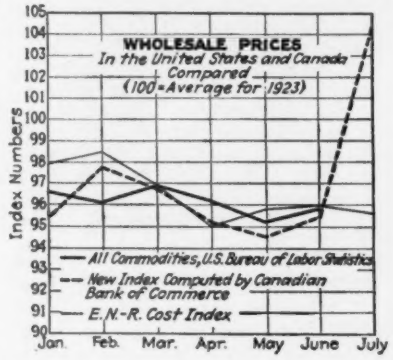
UNIVERSAL POWER SHOVEL COMPANY has moved from Detroit, Mich., to Milwaukee, Wis., where it will occupy a new factory and executive offices. The Detroit district will be served by a branch office.

DETROIT STEEL PRODUCTS COMPANY, Detroit, Mich., has published a standard discount sheet in accordance with the code of approved business practice recently drawn up by the manufacturers of solid section steel windows in co-operation with the Federal Trade Commission. It is expected that other companies in the industry will soon follow this example, thus eliminating unfair methods of competition and uneconomic trade practices.

Construction, Labor and Material

Costs in U. S. and Canada Agree in June

General construction costs and wholesale prices in Canada and in the United States check closely for June, the value being 96 for this country and 95 for Canada, both based on the 1923 average. The wholesale price index for this country for July will not be issued by the



Department of Commerce for another month. The new wholesale price index number of the Canadian Bank of Commerce was 104.24 on July 15; U. S. construction costs were 95.5, and retail food prices in the United States in June were at 105.8. All these figures are very close to year ago levels. The accompanying chart shows this year's trend for wholesale prices in the two countries.

Tariff Charges May Affect Construction Materials

Cement and brick remain dutiable, while shingles are returned to the free list in the tariff bill reported Aug. 20 by the Senate finance committee. All three of these contended items are duty free in the Fordney-McCumber act, now in force. Under the proposed rates manufacturers of brick and cement serving seaboard markets receive substantial support against mounting imports, principally from Belgium, which are shipped into this country largely as ballast. The lumber industry probably gains more than it loses by the return to the free list of shingles and also of cedar, fir, spruce and Western hemlock logs, because of the large Canadian holdings operated by American firms. The shingle duty was strongly opposed by the farm group. The deleted House rate on shingles was 25 per cent ad valorem.

The proposed duty on portland and other hydraulic cements is 8c. per hundredweight. Brick, not specially provided for, are assessed at $1.25 per thousand plain and if glazed, vitrified or ornamented, 5 per cent ad valorem but no less than $1.50 per thousand.

Among other construction items which received changes, ground or calcined gypsum or plaster rock took an increase from $1.40 to $3 per ton. Crude magnesite, a stucco and brick component, has been raised from ⅝c. to 1¼c. per pound. Structural steel is unchanged except that the term "building forms" has been stricken out as meaningless. Indicative of the rising cost of steel is the fact that the lower bracket including steel valued at not more than 1c. per pound has been eliminated as an anachronism. In general, the tariff on steel has been increased about 19.4c. per long ton to compensate for the Senate free listing of manganese and for other reasons.

New Capital Recovers in July

After rising to a record peak in May and falling off 48 per cent in June, new security issues in July exceeded in value those of that month for the last five years. Excluding refunding bonds, the month's net is $880,000,000, and for the seven months, $5,454,000,000. Corporate common stock issued in July totaled $447,000,000, or nearly 200 per cent of the value issued in July, 1925-1928. The value for the year is $2,555,000,000, or 43 per cent more than the total for the last four years. Public financing in millions of dollars has been as follows: In July $78, and $80 a year ago; in seven months $734, and $830 a year ago. Financing by investment trusts and holding companies amounted to 25 per cent of the month's total and 20 per cent for the seven months.

Excluding miscellaneous financing made up largely of investment trusts, holding and trading companies, private engineering construction for the seven months amounted to 51 per cent of net new capital, compared with 52 per cent for the seven months of 1928. Public construction amounted to 108 per cent of 1929 bond issues, and 91 per cent in 1928.

E. N.-R. Index Numbers

	Cost		Volume	
Aug. 1,	1929	205.91	July,	1929 320
July, 1,	1929	204.77	June,	1929 347
Aug. 1,	1928	207.29	July,	1928 266
Average,	1928	206.78	Average,	1928 287
Average,	1927	206.24	Average,	1927 263
1913.....		100.00	1913.....	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Aug. 22, with some comparisons, total as follows:

(In Thousands of Dollars)

	Aug. 22, 1929	Aug. 15, 1929	Aug. 23, 1928
Building:			
Industrial.....	$12,565	$2,866	$9,669
Commercial...	78,218	22,579	58,763
Streets and roads.	15,323	6,964	15,774
Other eng. constr.	9,058	19,829	5,297
Total.....	$115,164	$52,238	$89,503
Total, all classes, Jan. 1 to Aug. 22:			
1929.....			$2,838,498
1928.....			2,337,475